Second Edition—Revised and Expanded

TEACHING ABOUT VISION

by the Joint Study Committee of the
American School Health Association and the
National Society for the Prevention of Blindness, Inc.

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The American Health Association, established in 1927, strives to promote comprehensive and constructive school health programs—health instruction, health services, and healthful school living. The Association operates through an executive committee and governing council with special committees providing services in specific areas. The *Journal of School Health* is received by the membership education and health professionals making up the "school health team."

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PREFACE

The intention of this manual is to serve all school personnel, but its specific use is as a teaching guide for the classroom teacher, the health educator, and health service personnel involved in promoting the eye health of school children. It emphasizes the growth of the eye and development of visual functions and explains how children may increase their understanding and appreciation of vision. Furthermore, it should serve as a reference tool for allied health specialists, such as nurses, nutritionists, safety personnel, and physical educators.

Vision is unquestionably one of our most important senses, therefore teaching children to protect and make the best use of their eyes is essential.

Although the approach and methodology may differ at various grade levels and in different learning situations, the three basic educational goals are as follows:

1. To develop in children an understanding of the value of sight and a desire to make the best use of it;
2. To teach children how to protect their eyes and to help them understand the importance of this;
3. To help children understand the interrelationships between eye health, mental and physical health, and learning.

Vision also influences, and is influenced by, our general health and physical well-being. Thus, knowledge about the eye and its function is an integral part of the child's health education. The teaching of vision in the classroom should utilize children's interests at certain age levels by keeping information and interpretation within the limits of their understanding. In order to aid the teacher to do this, certain subject matter and study activities have been assigned to specific grade levels.

Teachers are advised to read the material for all levels in order to be aware of what experiences may have preceded, and what may follow, their own grade level of instruction. At all levels, the communication of ideas and the development of pupil interest and involvement is the primary aim—not learning terminology—or only factual information on the structure and function of the eye.

Teachers themselves will need to adapt some of the material to the experience and learning levels of their students. Shifting of some material to

the curricula of other grade levels, or repetition of subject matter, encourages learning and building of concepts in a continuous and expanding sequence as student abilities and interests develop.

In order to do things effectively there are certain facts about eye development which all teachers should know. Each section is introduced by a brief discussion of eye development appropriate to children at the age and grade level covered there. The learning activities presented are only examples and it is expected that the instructor will use them mainly as stimuli for their own imaginations.

The bibliography is arranged to correspond to the six main sections of the guide. In addition, health texts which cover vision as well as a list of some films and filmstrips are included. The textbooks each carry additional references which might be worthwhile. It is recommended that in teaching each of the units covered in the guide, the teacher supplement her presentation with related resource materials such as those listed in the bibliography.

This revision of Teaching About Vision was initiated in 1969 at the request of the Eye Health Committee of the American School Health Association and the National Society for the Prevention of Blindness. Under the chairmanship of Caroline Austin, a steering committee was selected to determine the basic philosophy to be presented, expansion of content in relation to new developments since the 1960 edition was printed and to consider a new format. Members of the steering committee were as follows: Caroline Austin, vision coordinator, Illinois Department of Health; Robert Blackhurst, M.D. chairman, eye care committee, Michigan State Medical Society; Julia Brandeberry, R.N., deputy director, Division of Nursing, Bureau of Health Manpower Education, National Institutes of Health; Mildred Doster, M.D., assistant director, Denver Public School, Health Services; Denis J. Kigin, Ph.D., dean, University Extension, Arizona State University; Walter Laborde, administrator, Sight Conservation Program, Louisiana State Board of Health; Gladys Lennox, chairman, eye health committee, American School Health Association, health services coordinator, South Shore Protestant Regional School Board, St. Lambert, Quebec, Canada; Otto Lippman, M.D., Austin, Texas; Mary McCann, M.D., Nutrition Program, Center for Disease Control, Department of Health, Education, and Welfare; Alfred A. Rosenbloom, O.D., dean, Illinois School of Optometry; Samuel M. Schall, M.D., member, Illinois Statewide, Joint Professional Committee on Children's Vision; National Society for the Prevention of Blindness, Wilfred D. David, M.D., executive director, Virginia S. Boyce, assistant executive director, Helen L. Woods, R.N., nurse consultant.

The Committee met for a full-day's discussion in January 1970. Unfortunately, during the year Caroline Austin found it necessary to resign due to the pressures of her position.

Therefore, a special joint study committee on vision was appointed representing the ASHA and the NSPB to serve for one year and to complete the revision. Members were as follows:
Mildred Doster, M.D., chairman, assistant director, Denver Public Schools Health Services; Virginia S. Boyce, co-chairman, assistant executive director, National Society for the Prevention of Blindness, Inc.; Charles J. Baer, director, Heaith, Education, & Services, Kokomo-Center Township, Indiana, Consolidated School Corporation; Robert T. Blackhurst, M.D. chairman, eye care committee, Michigan State Medical Society; Julia Brandeberry, R.N., deputy director, division of nursing, Bureau of Health Manpower Education, National Institutes of Health; Otto Lippman, M.D., Austin, Texas; Mary McCann, M.D., nutrition program, Center for Disease Control, Department of Health, Education, and Welfare; Robert H. Shorr, O.D., Detroit, Michigan; Virginia Thompson, R.N., School Health Services, Houston Independent School Systems; Helen L. Woods, R.N., nurse consultant, National Society for the Prevention of Blindness, Inc.; Wilfred D. David, M.D., *ex officio,* executive director, National Society for the Prevention of Blindness, Inc.; Elizabeth A. Neilson, Ed.D., *ex officio,* director, Continuing Education, American School Health Association.

We gratefully acknowledge the outstanding contributions of Marion V. Hamburg, Ed.D., associate professor and director of health education, New York University School of Education, in providing valuable advice and material for the sections, entitled "Suggestions for Teachers," and of Mrs. Bruce Terry, second grade teacher in Patchogue, Long Island, New York, whose teaching plans served as a valuable reference.

We would like to express appreciation to the individuals, agencies, and publishers who have provided materials which have served as valuable references in the revision of this guide. It would be impossible to list them all.

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CHAPTER 1

HOW WE SEE

A. Parts of the Eye

The parts of the eyes and their function are worth knowing well. There is much that can be done to prevent the loss of vision from disease or defects of the eyes. They are in constant use during every waking moment, so that proper care, rest, and good lighting are recommended.

To understand the eyes and how they work, it is helpful to know what their parts are. The figures and definitions which accompany this chapter should be an aid in understanding the discussion.

Starting from the outside front, the eye consists of the CONJUNCTIVA, a thin, moist, protective membrane that covers the inner layer of the eyelid and then curls back to cover the SCLERA, the tough opaque white of the eye, finally attaching to the margin of the CORNEA, the circular, transparent, convex "front window" of the eye. The SCLERA is lined by the CHOROID, a dark thin membrane containing numerous blood vessels which furnish the outermost part of the RETINA, which lines it, with nutrition. Behind the cornea is the ANTERIOR CHAMBER containing AQUEOUS HUMOUR, a clear watery fluid which helps maintain intraocular pressure, supports the metabolism of the lens, and contributes to the nutrition of the cornea. The aqueous is excreted through the CANAL OF SCHLEMM after it has circulated. At the back of the anterior chamber is the IRIS, the round, colored, adjustable diaphragm. If one has blue eyes, it is because the iris has less pigment than the iris of a dark eyed person.

The PUPIL is the circular opening at the center of the elastic iris. Behind the iris and the pupil is the CRYSTALLINE LENS, a curved transparent, flexible capsule held in place by the SUSPENSORY LIGAMENT. The POSTERIOR CHAMBER, behind the lens, is by far the largest part of the eyeball and is filled with a clear, colorless, solid jelly

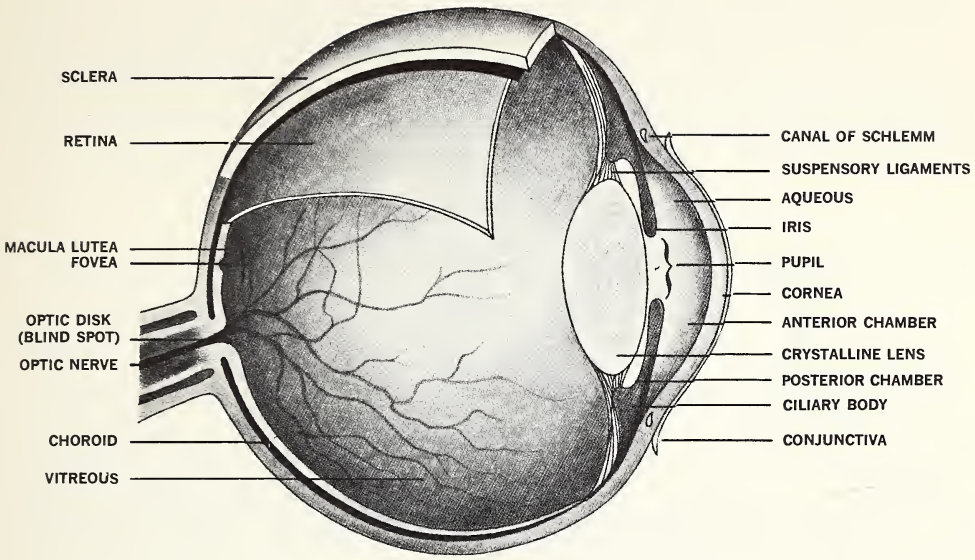


FIG. 1. Structure of the eyeball

called the VITREOUS BODY. Since the line of sight through the cornea, aqueous humour, lens, and vitreous body must be completely clear, no blood vessels enter this area. The RETINA, a light sensitive layer of nerves and receptors, connect with the brain through the OPTIC NERVE and with the RODS and CONES, which line it. It is here that the image is focused. At the point that the optic nerve enters the retina there is a normal blind spot, the OPTIC DISC. The center of vision, or fixation point, is a small area in the retina in the posterior pole of the eye, the FOVEA CENTRALIS. The retinal nerve cells in this place are the cones which have to do with color and form and central vision. Outside of this area, moving toward the ciliary body, the rods, which have to do with peripheral, or side vision, become more predominant. The MACULA LUTEA, the area surrounding the fovea centralis, is used for less acute central vision.

B. How the Eye Functions

Vision is a complex function that requires more than the eye alone. The act of seeing requires light to see by and the brain to interpret what is seen. As light strikes an object in a person's field of vision, the light rays are reflected from the object to the eyes. The rays pass through the cornea, through the aqueous humour, and through the pupil of the iris which

widens (dilates) or narrows (contracts) to allow more or less light in according to the brightness of the object. In addition, the pupil contracts when it looks at something small in order to increase the sharpness. The rays then pass through the crystalline lens. The cornea and lens of the eye combine to bend the light rays as they pass through and automatically focus them on the retina, particularly the fovea centralis.

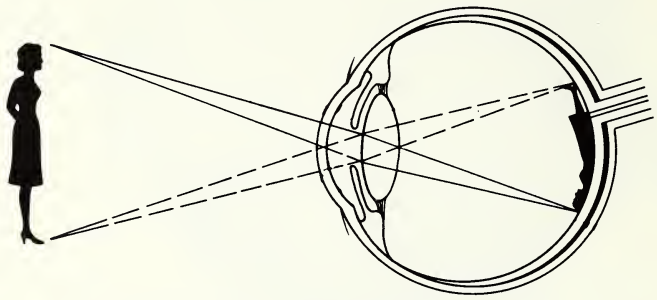


FIG. 2. The human eye—How we see

The lens operates much as a camera lens in focusing light rays precisely on the retina. It does the "fine tuning" by changing its shape through the action of the ciliary muscles. The fluids in the aqueous humour in front of the lens and the vitreous body behind the lens allow it to expand and contract easily. The thicker the lens, the stronger is its power. The rays pass through the vitreous body and penetrate the retina, where they set up a photochemical response in the outermost layers, there stimulating the rods and cones. The impulse is picked up by the retinal nerve fibers and passes along the optic nerve to the brain where an upside down image is formed (see Fig. 2). Based on experience, the upside down image is psychologically transposed.

PARTS OF THE EYE

ANTERIOR CHAMBER

Space in the front of the eye, bounded in front by the cornea and behind by the iris; filled with aqueous

AQUEOUS HUMOUR

Clear, watery fluid which fills the anterior and posterior chambers within the front part of the eye

CANAL OF SCHLEMM

A circular canal situated at the juncture of the sclera and cornea through which the aqueous is excreted after it has circulated between the lens and the iris and between the iris and the cornea

CHOROID

The vascular, intermediate coat which furnishes nourishment to the other parts of the eyeball

CILIARY BODY
Portion of the vascular coat between the iris and the choroid. It consists of ciliary processes and the ciliary muscle

CONJUNCTIVA
Mucous membrane which lines the eyelids and covers the front part of the sclera

CORNEA
Clear, transparent portion of the outer coat of eyeball forming front of aqueous chamber

CRYSTALLINE LENS
A transparent, colorless body suspended in the front of the eyeball, between the aqueous and the vitreous, the function of which is to bring the rays of light to a focus on the retina

FOVEA
Small depression in the retina at the back of the eye; the part of the macula adapted for most acute vision

IRIS
Colored, circular membrane, suspended behind the cornea and immediately in front of the lens. The iris regulates the amount of light entering the eye by changing the size of the pupil

MACULA LUTEA
The small area of the retina that surrounds the fovea and with the fovea comprises the area of distinct vision. Syn. *yellow spot*

OPTIC DISK
Head of the optic nerve in the eyeball

OPTIC NERVE
The special nerve of the sense of sight which carries messages from the retina to the brain

POSTERIOR CHAMBER
Space between the back of the iris and the front of the lens; filled with aqueous

PUPIL
The contractile opening at the center of the iris for the transmission of light

RETINA
Innermost coat of the eye, formed of sensitive nerve fibers and connected with the optic nerve

SCLERA
The white part of the eye—a tough covering which, with the cornea, forms the external, protective coat of the eye

SUSPENSORY LIGAMENTS
A complex structure of multiple bands of tissue which hold the crystalline lens in place.

VITREOUS BODY
Transparent, colorless mass of soft, gelatinous material filling the eyeball behind the lens

The Muscles of the Eye and Movement

The movement of each eye is controlled by a set of six extraocular muscles which also give support and protection to the outside covering of the eye. A seventh muscle raises the upper eyelid. The following table shows the action of each of these muscles. See also Figs. 3 and 4.

Extraocular Muscles of the Eye

Muscle	Action	Movement
Internal rectus	Adduction	Move eye toward nose
External rectus (lateral rectus)	Abduction	Move eye toward temple
Superior rectus	Elevation, adduction, intorsion	Moves eye upward and outward
Inferior rectus	Extorsion, abduction, depression	Moves eye downward and outward
Superior oblique	Abduction, depression, intorsion	Tilts eye downward and inward
Inferior oblique	Abduction, elevation, and extorsion	Tilts eye upward and outward
Levator palpebrae		Raises upper lid

By contraction of a rectus muscle and relaxation of its opponent, the eye is turned in the direction of the acting muscle—up, down, or to either side. By a rather complex action, the oblique muscles tilt the eye. The muscles act in combination with each other to allow the eyes to move together instantaneously. The movement of these muscles is controlled by the cranial nerves. The synchronious movement of the two eyes in unison allows for greater efficiency in using our sight.

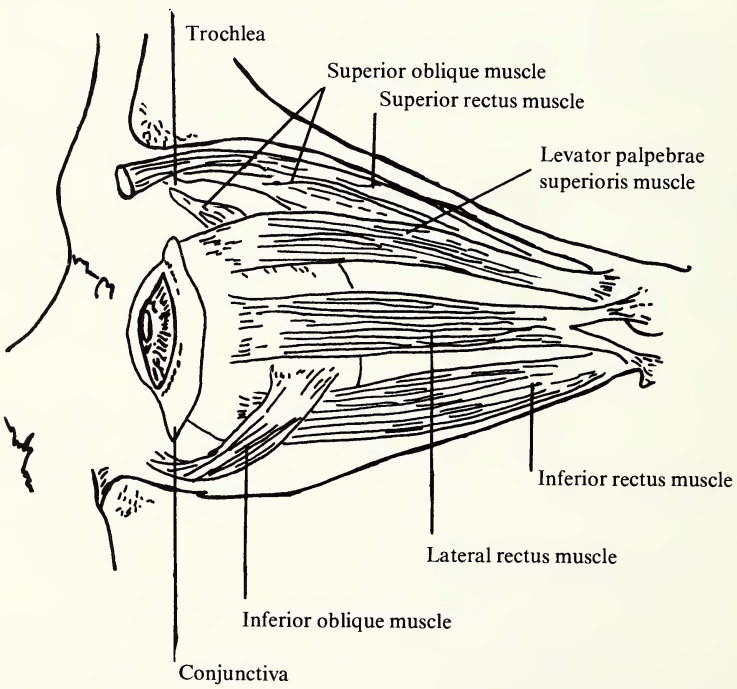
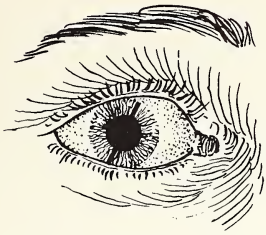
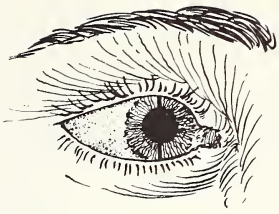


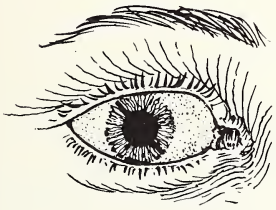
Fig. 3. Sideview of eyeball showing muscles. Reprinted, by permission from F. W. Newell, *Ophthalmology, Principles and Concepts,* p. 34, © 1969 by The C. V. Mosby Company.



Intorsion
(Incycloduction)



Adduction



Extorsion
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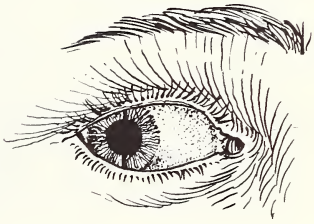

Abduction

FIG. 4. Ductions or monocular rotations of the eyeball. Reprinted, by permission from Vaughn, Taylor, Asbury, and Cook, *General Ophthalmology,* p. 173, © 1971 by Lange Medical Publications.

When the two eyes can function together, the fields of view fuse as a single image. Since the object seen is viewed at different angles, a stereoscopic effect is produced that gives us a sense of depth and perspective.

This section has described the normally developed eye. Abnormalities, however, can occur. Some of them are inherited, or congenital. Some of them are the result of injury, disease, improper development, or a faulty refractive system.

The next chapter shall discuss these briefly.

CHAPTER 2

REFRACTIVE ERRORS AND EYE DISEASE

A. Amblyopia

Amblyopia, included here as a special problem, is any reduction in visual acuity in one or both eyes, not correctable by refractive means and not attributable to obvious structural or pathological ocular anomalies.

Peripheral vision is present at birth or develops shortly thereafter. It is especially sensitive to any movement occurring in the field of vision. Infants follow lights and moving objects long before they can observe the details of their surroundings. Central vision is learned by practice in concentrating on the finer features of familiar shapes and outlines. This learning process automatically takes place in both eyes, however, if something upsets the delicate balance and coordination of the two eyes, there is a danger that only one eye will be used for seeing. The central image seen by the eye not used is shut out rather than experience the discomfort of double vision. The most common cause of the condition is faulty alignment of the eyes, i.e., one eye is turned inward or outward with respect to the other. If the eyes are looking in two different directions the child sees double. He escapes this annoyance by mentally shutting out the image of one eye. This condition is known as amblyopia or lazy eye, a tragic and unnecessary loss of vision among young children.

Amblyopia in a young child may not present a permanent reduction in vision since correction may be possible. Treatment may consist of glasses, patching, surgery, or a combination of procedures including eye exercises (orthoptics and pleoptics). See Fig. 5.

The goal of preschool vision screening programs is prevention of serious vision impairments through early detection and treatment of eye

FIG. 5. Treatment of amblyopia by patching fixating eye.

problems. The earlier that amblyopia is treated, the more successful will be the achievement of this goal. If the conditions which may lead to amblyopia are not identified and treated early, then a permanent reduction of vision may result.

B. Refractive Errors

Faulty optical conditions, or refractive errors usually may be classified in four basic categories: myopia, hyperopia, astigmatism, and presbyopia.

Myopia

Myopia, or nearsightedness, is usually first seen in children of around six to eight years of age. In these cases, the light rays are bent and focused in front of the retina, either because the eyeball is too long or the lens is too thick and curved so that it bends the rays too much.

As a result, the myopic child can see objects at near distances clearly, but cannot focus on objects at far distances. The hazard is that, especially in childhood, he might assume that his vision is normal. He can see clearly everything immediately around him, playmates and playthings, and consequently pays no attention to distant objects. If not corrected, it may affect him psychologically. In school, if he cannot see the blackboard and therefore misses lessons, he may assume that he is not as bright as the

other students. In play periods, if he misses a long fly ball because he cannot see the batter he might assume he is not as good a ball player as the others. Some undetected myopes, as a result, tend to develop withdrawn personalities.

Myopia can definitely affect a person's physical stature. Because he can see best at near distances, the myopic person is inclined to bend over his work. Especially persons who do a great deal of reading, may become stoop-shouldered from a long habit of bending. Some myopes tend to squint. By squeezing the eyelids together, they create a "pinhole effect," eliminating peripheral vision and concentrating on central vision through one small opening. The tendency to squint can become a permanent disfiguring habit.

The treatment for myopia is wearing eyeglasses, prescribed so that they help the cornea and lens aim the light rays to their proper position on the retina. During adolescence when the body is growing and changing constantly, myopia may develop and cause postural problems. The eyes should be examined periodically. After the age of 20, eye examination may occur less frequently until around age 35, when the start of presbyopia is often seen. Except for the squinting, the myope experiences no discomfort with or without glasses. With glasses, the myope's eyesight can be as sharp as those without refractive errors.

Hyperopia

Hyperopia, or farsightedness, can appear at any age. It is much more common than myopia, and its causes are almost the opposite. In this condition, either the eyeball is too short, and the focus falls behind the retina, or the lens is too thin and flat and does not bend the rays enough so the focus falls in front of the retina.

The result is that the hyperope can see better from a distance than he can from close up. If the person is young, and his eyes otherwise healthy, their normal adaptive powers can help him see clearly even at close distance without glasses. His short eyeball has been compared to a piano player with short fingers. He can play all the notes, but his fingers get tired sooner than a pianist with long fingers that glide effortlessly over the keys. The constant and forced adapting can tire the eye muscles and cause uncomfortable headaches, especially after close work.

One form of strabismus is also associated with farsightedness. If the hyperopia is severe enough, a young child may cross his eyes in an effort to adapt them for clear vision, thus, sometimes resulting in crossed eyes.

The treatment for farsightedness is eyeglasses for close work, so-called reading glasses, that the person can use to relieve the effort involved in

adaptation; milder hyperopes often do not need their glasses when engaged in activities requiring longer range of vision such as driving or watching a movie.

If hyperopia appears early, a parent may notice that the child has difficulty reading, or frowns, or squints, or rubs his eyes. If it appears later, the hyperopic adult will notice it himself when his vision blurs for close work, or when, after periods of long use, he gets headaches.

Astigmatism

Astigmatism, is the irregular or defective curvature of the refractive surfaces of the eye (cornea, lens) resulting in a diffusion of light rays on the retina preventing sharp focus. It affects the vision at all distances.

If the astigmatic person looks at a figure consisting of straight lines radiating out from a center, he may see clearly only the lines pointing in one direction while the lines radiating out in another direction are blurred. Eye specialists find that almost everyone has astigmatism to some degree, but most of it is too slight to be noticeable. When it becomes pronounced, however, it affects the vision and may produce physical discomfort. The astigmatic person may also twist his body in order to get the normal areas of his corneas in position to see properly. He may frown when he reads, or squint to constrict his pupils so that only one ray of light comes in instead of several conflicting ones; i.e., some from the properly curved portion of the cornea, and some from the faulty curvatures.

Probably the worst hazard, especially in the young, is that the astigmatic person may develop an aversion to reading which would affect his learning habits.

Most causes of astigmatism can be corrected with glasses, although the problem may be unusual enough to require contact lenses. Few cases are so severe that they cannot be corrected. It is important to get this condition corrected before the ages of 6 or 8, so that the child develops the best vision possible. If uncorrected, the child may develop bilateral amblyopia.

Presbyopia

Presbyopia, is loss of the ability to focus sharply on objects close to the eye, seen in older people. At age 10, a normal eye can fix upon objects as close as 4 inches. This ability to focus the eye for close work is gradually lost, so that by age 30, the near point of focusing is usually about 5½ inches. At 45, the near point is about 16 inches.

Between the ages of 40 and 50, individuals may find this condition becoming troublesome. The lens gradually loses its elasticity and there is less ac-

commodation with each year of life. This is not a disease. It must be faced as a normal part of the aging process. Presbyopia is, therefore, known as the "vision of the mature."

The condition progresses until, in old age, all power of accommodation is lost. Nothing can be done to restore the elasticity of the lens. Instead, the ophthalmologist and optometrist prescribe glasses for close work such as reading and sewing.

They can prescribe other glasses for pianists, for example, who do not hold their music as close. Bifocals may be prescribed for drivers who wish to use the upper half of the glasses to watch the road and to use the lower half for glancing at the speedometer.

C. Common Eye Diseases

Two serious and relatively common eye problems that usually show up after 40 years of age are cataracts and glaucoma.

Cataract

A cataract is a cloudiness of the lens; it may reach a state where vision is obscured altogether. Some cataracts are caused by hereditary influences, others by injury or bodily disease, some by drugs given for other ailments, and some accompany other eye diseases.

By far, the most common cataracts, however, are the senile type, the kind ophthalmologists suggest everyone would develop if they lived long enough. No cause is known and there is no prevention. After 65, everyone shows opacities but in some they show little tendency to progress.

Cataracts are a leading cause of blindness. However, cataract is no longer the feared handicap it was a few generations ago when it could mean permanent blindness. Although usually stationary, clouding only a portion of the lens, cataracts may sometimes be progressive and eventually cloud so much of the lens that they interfere with a person's normal activities. Even then, the situation is not hopeless. A comparatively safe operation—about 98% successful—can remove the clouded lens. The part of the focusing process performed by the lens can be provided by prescription glasses, with the cornea still doing its part.

Glaucoma

Glaucoma can be more serious. It causes an estimated 15% of all blindness in this country, and about half of all adult blindness. Increased pressure within the eyball presses on the optic nerve and, if not relieved, can destroy the nerve and cause permanent blindness.

In one form, *acute glaucoma,* the onset is sudden and without warning. When the iris and cornea are pressed together, there is interference with the circulation of the aqueous humour fluid preventing normal outflow. As the fluid accumulates, the pressure builds up rapidly, causing agonizing pain. The eyeball gets stony hard and red, and the cornea gets gray and cloudy. It occurs most frequently in those of middle and advanced age, especially women, particularly during periods of excitement when the blood flow increases precipitously.

In this type of acute glaucoma, surgery is almost always necessary to relieve the pressure. It usually must be performed within 24 or 48 hours, or the nerves can be permanently damaged.

A more common form among adults, *chronic glaucoma* is more dangerous because it is insidious. There is no sudden warning. It sneaks up on the individual over a period of years. This is the primary reason for having periodic eye examinations after 35 and especially after 65.

In chronic glaucoma, the drainage system of the eyeball is slowly obstructed so that there is a gradual buildup of pressure. The loss of sight is gradual and almost unnoticeable, because it starts from the periphery of the visual field and works in toward the center. It is estimated that one million Americans have chronic glaucoma and do not know it. Every year about 4,000 of them go blind.

The tragedy is that these cases might have been detected in their early stages and controlled. Damage of the nerves caused by pressure cannot be revised later on. The victim usually has no symptoms, though occasionally he may notice vague and unpredictable headaches, watering of the eyes, poor vision in dim light, blurred foggy vision with rainbow halos around lights, loss of side vision, and visual difficulty in changing from light to dark surroundings. With these signs, even if he can see well straight ahead, he should not assume there is nothing wrong. If any of these symptoms exist, a person should get further eye and visual evaluations.

A professional eye examination, including tonometry, could pick up the slight change in intraocular pressure before it has progressed too far. Regular medication could control its progress thereafter. Drops in the eyes can unblock the drainage system, and oral medicine can reduce the amount of fluid going to the eyes.

CHAPTER 3

VISION PROBLEMS: Observation of Children and Vision Screening

A. Observation of Children for Eye Problems

Observation by the teacher is a vital part of the vision screening of children. The observant teacher carefully watches the total growth and development of the child as well as his academic achievement. The close day-by-day contact with children places the teacher in a key position to continuously note changes in their appearance and behavior and to recognize signs of eye trouble that invite further investigation.

This observation should be correlated with the vision screening procedure regardless of method used. For example, if a child persistently exhibits signs and symptoms or makes complaints in the classroom that may indicate eye trouble, he should have a professional eye examination even though his school vision screening test shows no deviation from accepted limits.

Some Signs of Eye Trouble in Children

The following list will give the teacher some examples of the signs and symptoms to be watched for that may not be detected in vision screening. Visual problems frequently cause changes in behavior and appearance in addition to complaints (see Fig. 6).

FIG. 6. Warning signs of eye problems affecting children: attempts to brush away blur; frowns excessively or tilts head to one side; squints or blinks more than usual.

Close observation for these indications of eye problems will often bring a child to the attention of a physician well in advance of a screening.

BEHAVIOR

Rubs eyes excessively
Shuts or covers one eye, tilts head or thrusts head forward
Has difficulty in reading or in other work requiring close use of the eyes
Blinks more than usual or is irritable when doing close work
Holds books close to eyes
Is unable to see distant things clearly
Squints eyelids together or frowns

APPEARANCE

Crossed eyes
Red-rimmed, encrusted, or swollen eyelids
Recurring styes

COMPLAINTS

Eyes itch, burn or feel scratchy
Cannot see well
Dizziness, headaches, or nausea following close eye work
Blurred or double vision

B. Recommendations for Vision Screening

A complete, competent, professional eye examination for every child before entering school and at stated strategic intervals during school life is the ideal goal. Until this goal is attained, vision screening programs during the preschool and school years are necessary to identify children who may be in need of eye care, so they can be directed toward adequate professional attention. Statistical studies show that 25% of children of school age may have some eye difficulty which may require professional care. If a student has poor vision, and this fact is not known, the difficulty may affect his learning abilities and entire adjustment in school.

Screening Is Not Diagnostic

Vision screening in schools should not be considered diagnostic. Only certain visual skills are tested. Careful observation by both the teacher and tester is necessary in order to detect symptoms of eye trouble. If the student's visual ability is not in a "passing" range of established criteria, or if the child shows certain symptoms, the need for a professional eye examination is indicated and he is then referred. Screening will not locate every child who needs eye care, nor will every child so referred need glasses or treatment. Screening, as the term implies, only sorts out most of those children who may have eye problems.

Basic Minimum Procedure

The National Society for the Prevention of Blindness suggests that the ideal, in lieu of a professional eye examination, would be an annual test for distance visual acuity.

Recognizing the problems of manpower shortage and follow-up, the National Society recommends, as a basic minimum, a careful screening for distance visual acuity using the linear method (exposing a total line of symbols) according to the following plan:

1. Kindergarten or first grade (5-6 years): use of the Snellen E symbol chart.
2. Second (7 years), fifth (10-11 years), eighth (13 years), tenth or eleventh grade (15-17 years), and prior to driver education: use of lines of letters except where there is difficulty identifying the letters.
3. All new registrants and teacher referrals should receive vision tests.
4. All children who exhibit change in behavior or learning disability.
5. *All* individuals under care should be *retested* regularly to encourage continuity *of appropriate treatment.*

With such a plan, there is a great opportunity to ensure as complete a follow-up as possible on all referrals. Continuous observation by teacher

and tester and periodic nurse-teacher conferences are desirable for an exchange of information pertinent to the health of the child.

Routine screening may be done by various specially trained persons as the nurse, teacher, health aides, or volunteers. Before referral for follow-up care it is valuable for the school nurse to secure a brief but adequate history, including such information as familial or hereditary eye disease, prenatal maternal disease, premature birth, or a history of injury to an eye by illness or accident.

It is recommended that neither ophthalmologists nor optometrists conduct vision screening tests. Experience has shown that when screening is done by these practitioners parents may misinterpret the procedure as being an eye examination. At best the test screens out those likely to have vision defects, and regardless of who does it, some children who need eye care will be overlooked while some will be referred who do not need it.

Authorities agree that a careful, painstaking test for central distance visual acuity is the most important single test of visual ability. This identifies more children who require eye care than any other single test. With normal vision, the largest letter on the Snellen chart should be visible at a distance of 200 feet. Similarly, a person with normal vision should be able to identify the 20-foot line standing 20 feet away. Hence, the expression 20/20 vision. The first number is the number of feet from the person to the chart. The second, or denominator, is the line seen at that distance. Under proper conditions of illumination (10-30 foot candles)* the chart tests the individual's ability to perceive form at 20 feet. This distance represents infinity in the test because light rays are almost parallel as they enter the eye from 20 feet or further away. Form sense, or the ability to perceive the shape of objects, has been called the essence of vision.

When a 20-foot student-to-chart distance cannot be obtained, a chart drawn to scale for use at 10 feet is approved.

It is possible to use the 20-foot chart at 10 feet by installing an optically correct mirror at approximately 10 feet facing the chart. The total distance from chart to mirror to child should equal 20 feet, i.e., 12 feet chart to mirror, 8 feet mirror to seated child. Chart is placed so average sized child's eye will be level with critical line.

The combination of teacher and tester observation of the child and the Snellen test has been shown in several research studies to have a high correlation with clinical findings by ophthalmologists. This procedure is inexpensive, requires little time per student, and is easy to administer.

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*A common unit of illumination, the foot candle, is one lumen per foot or equivalent to 1.0764 milliwatts.

Screening with isolated test symbols is recommended for use with preschool age children (below age 5). In kindergarten, screening with exposure of a whole test line is recommended. The vision of children with amblyopia may be better when letters are presented singly to the eye than when presented in a series. This is because a "crowding effect" results when more than one letter is viewed.

In order that the child's best possible vision is on record for future reference, all children should be tested to the 20/20 line if possible, regardless of the line established as the visual acuity criterion for his age.

Practical criteria for referral when using the Snellen test (either isolated symbol or linear method)* are as follows:

Kindergarten Through Third Grade: Vision of 20/40 or less. The designation 20/40 or less indicates the inability to identify accurately the majority of letters or symbols on the 30-foot line of the test chart at a distance of 20 feet.

Fourth Grade and Above Vision of 20/30 or less. This means the inability to identify the majority of letters or symbols on the 20-foot line of the chart.†

All Grades: Same line difference between the two eyes within passing criterion, using the isolated symbols method of testing.

Those who do not pass according to the established criteria should have the test repeated on another day with referral depending on two successive failures.

It is recommended that the vision of children who wear glasses be tested both without and with glasses. In the follow-up for children who wear glasses, determination of the need for a referral should be based on visual acuity without and with glasses, the date of the last correction, the date for the next examination, and observations of parent, teacher, and tester.

Sometimes, contact lenses are worn in the later adolescent years; they are rarely indicated for younger students whose vision is still changing rapidly. If contact lenses are worn, this fact should be noted on the vision record.

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*These basic tests and criteria for referral may be affected by local conditions such as availability of care or socioeconomic factors among the school populations. Inasmuch as there are differences of opinion *also* as to which tests should be used in a school screening program, the decision as to method and *criteria for referral* should be established locally, utilizing the best knowledge, experience and judgment of the school administrator, school physician, school nurse, health educator, and the eye care practitioners who might examine the referred children.

†If a lower visual acuity criterion for referral is adopted (i.e., vision of 20/50 or less) and the linear method used, then a two line difference between the two eyes within the passing range should be reason for referral.

Additional Tests

Other tests, such as the following, may be added to this basic minimum procedure if the local School Eye Health Committee believes it is advisable.

Plus Lens Test for Hyperopia. To determine whether there is a possibility of latent hyperopia, the student's vision is checked while he is wearing a pair of convex or plus lenses. The lenses (mounted in an inexpensive plastic or metal frame) should be of a plus 2.25 diopter strength* for the first three grades, and plus 1.75 for the fourth grade and above. The ability to see the 20-foot line at 20 feet from the chart with both eyes while wearing these lenses represents need for referral. It assumes that the child probable has as much hyperopia as represented by the lens, or more.

It is sometimes urged that a visual acuity near-point test with cards held at 14 or 16 inches from the eyes be included in school vision screening procedures because so much reading at this distance is necessary in school.

However, many authorities agree that the plus lens test for hyperopia is a more reliable indication of the student's ability to accommodate for near-vision tasks. The reason for this is that most children have such a high reserve of accommodative ability that even those with a marked hyperopia may be able to focus on a near-vision test card for the few minutes that the test requires.

If a test for hyperopia is considered, the National Society recommends the plus lens central distance vision test. The near-vision test with cards held at 14 or 16 inches is not recommended as a routine procedure.

Muscle Balance. In testing muscle balance, or the ability of the two eyes to work together, instruments or devices are used which cause fusion to be disassociated or frustrated, and thereby reveal imbalance. Fusion may be dissociated either with a type of lens known as a Maddox rod, by use of a stereoscope in some form or by use of color. The object is to present a different image to each eye at the same time. A measurement of the relationship of the two images as seen by the child can be estimated. This measurement is commonly made not only for a distant object but also for a near object. All such measurements are made with the eyes looking straight ahead.

The unit of measurement in this test is a prism diopter, or the amount of deviation of light by an ophthalmic prism. The usual criteria for referral for the muscle balance test for outward lateral deviation (exophoria or

*A lens that focuses or brings together rays of light at a point one meter away is called a one diopter lens. If it focuses the rays of light at a point half a meter away it is known as a two diopter lens, etc.

exotropia) are: (1) more than four prism diopters for a 20-foot distance, and (2) eight prism diopters for near objects. (3) The criterion for referral for inward deviation is six prism diopters for either distant or near objects. (4) The criterion for referral for a vertical deviation is greater than one prism diopter.

Depth Perception Tests. Stereopsis or visual perception of three-dimensional space, may be important in relation to vocational placement and these tests should be added in high schools and in vocational schools.

Three of the tests described (visual acuity, plus lens, and muscle balance) have come to be known in battery form as the Massachusetts Vision Test. This test was first developed in 1938 by the Massachusetts Department of Public Health.

No manufacturer is currently producing a device bearing this specific name. However, several companies have produced binocular testing instruments which incorporate the three tests of the battery as well as tests for driver education and vocational placement purposes (see appendix).

Use of Machines for Vision Screening

Before any binocular equipment is purchased for a school system, those responsible for the vision screening program, particularly the school physician and the eye specialists, should be familiar with the criteria to be used for referral. Personnel using these instruments should have special training in their use and maintenance in addition to having the basic *vision screening* course.

Controversial Factors. The decision to use tests in addition to the Snellen test, plus teacher and tester observation, depends on several factors:

1. Accuracy of performance by those doing the screening.
2. Overreferrals or underreferrals.
3. Parental attitude. Parents may question the validity of the entire program if there are excessive overreferrals from additional tests.*
4. Community resources. A careful study of community resources is indicated before making the decision to use additional tests in the screening program.

The goal of screening is to obtain adequate, competent care when necessary for as many children as possible. Follow-up *tends* to be neglected when time is spent in mechanics of administering additional tests especially when large numbers of students are involved.

*As a statement of general application, the additional tests are not done unless records show that 85-90% of the children previously referred through Snellen testing, coupled with teacher and tester observation, have received professional eye examinations.

Gradual Start Recommended

When a three-part vision test battery is introduced it is sometimes practical to start gradually. Determination of distance acuity, plus teacher and tester observation, should precede the plus-lens test. Later, the tests for muscle balance can be added. In those programs which follow the ideal of an annual vision test, the complete battery might be used every two or three years, with Snellen distance testing coupled with careful teacher and tester observation in the other years.

When a program is initiated and agreement has not been reached among eye care practitioners as to the types of tests to be used or the criteria for passing, it is better to limit the vision screening to the Snellen test combined with teacher and tester observation and to lean toward more liberal criteria. For example, children might be referred who have visual acuity of 20/40 or less, instead of 20/30. This procedure will not locate as many children who need eye care, but it will produce fewer unnecessary referrals and less disagreement among parents and the professional examiners.

It will help to build up confidence in the program from the beginning. Later, criteria for referral may be raised, using 20/30 instead of 20/40 for passing, and the three-part vision test battery may gradually be scheduled as suggested above for all children above the first grade.

Tests for Color Discrimination

It is recommended that a test for color discrimination be given each child at least once during his school experience. Deficiency in this visual function is not correctable, but it is important for students and parents to be aware of any such condition. Vocational counselors should be advised because the main purpose of this testing is to prevent the student who has difficulty with color discrimination from choosing a vocation for which he is not suited.

Sets of pseudoisochromatic plates, put together in book form, are recommended. Plates are available in which numbers are outlined in the primary colors and surrounded by confusion colors. The color-deficient individual is unable to see the figure that a person with normal color discrimination can see easily. Two such tests which have proved satisfactory for school use when instructions are faithfully followed are the Hardy-Rand-Rittler Pseudoisochromatic Plates Test and the Ishihara Test.

Unless tests for color discrimination are given under correct illumination, the results are not reliable. It is recommended that the instructions for illumination included with the tests be closely adhered to.

CHAPTER 4

TEACHING ABOUT EYE DEVELOPMENT AND FUNCTION

This chapter will present a discussion of eye development at each of the following grade levels: preschool and kindergarten, early elementary (1st, 2nd, and 3rd grades), upper elementary (4th, 5th, and 6th grades), and early adolescence (7th, 8th, and 9th grades). Each discussion is followed by a section of basic concepts to be considered and suggested learning activities to aid in the teaching of these concepts.

A. Preschool and Kindergarten

The kindergarten child should not be required to look at very close objects for too long, thereby causing restlessness and fatigue.

The fully developed eye (approximately 8 years of age) is constructed in such a way as to cause light rays coming into the eyeball to be bent by parts of the eye, mainly the cornea and lens, so that the light rays may come to a sharp focus on the retina at the back of the eye. As the individual attempts to see small objects near to him, the lens can change its size and becomes thicker in order to help to focus the light rays.

Due to their partially developed eyeballs five- and six-year-old children are normally farsighted (hyperopic). Some hyperopic children are going to experience stress because a great deal of effort will be exerted by the muscles which adjust the size of the lens to bring the light rays to sharp focus at the back of the eye.

Because farsightedness is present in so many children at this age, it is advisable to adjust their eye-use to their reading-readiness rather than to use glasses to reduce their normal farsightedness which will usually be out-

grown in a year or two*. In order to adjust to his farsightedness, the young child's critical seeing periods should be of short duration—less than an hour—and small movements, as in art classes, should be avoided.

Immature eyes produce another vision problem. At the same time that the muscles of the lens adjust their size to get a sharp image on the retina an impulse is sent to those eye muscles that control the position of the eyeballs to turn them inward so that both eyes are looking directly at the object. The amount the muscles turn the eye in is coordinated with the amount of action by the muscles controlling the size of the lenses. This balanced system does not usually stabilize completely until the eyeballs reach their full growth at about eight years of age.

Children of five or six years of age may have eyeballs which are shorter from front to back than they will be when they are full grown. As a result the muscles which control the thickness of the lens must overact in order to bring the light rays to a focus within a shorter distance. The smaller the object, the sharper the focus on the retina must be in order to get a clear picture. For some children, the accompanying overaction of the muscles of convergence tends to turn the eyeballs in too far. If the ability to use the two eyes together has not become fixed so that it can hold this tendency in check, the child may have blurred or double vision when looking at close objects.

Other children, however, are better able to coordinate the focusing of the lens with the proper muscle convergence and are able to see clearly for short periods of time. This balance is hard to maintain over a long period of time. If the child is forced to use his eyes for near tasks until he is fatigued, he will have difficulty seeing clearly.

Voluntarily, he may react by closing one eye by covering it with a hand or lid or, involuntarily, turning one eye in so far that the brain will refuse to accept the picture it receives. In this way he relieves the fatigue of maintaining binocular vision.

Another child, upon finding maintenance of the focusing-convergency relationship too much effort, may stop working at the task requiring it. He may develop an actual dislike for activities requiring close work and exhibit a negative reaction to them. If children are forced into a reading situation before their eyes are fully developed, they frequently become nonreaders or seriously retarded readers. They may have adequate, even high, intelligence yet may become poor readers and thus be indifferent or resistant to some parts of the school program. Reading readiness also depends on

*Hyperopia beyond the normal amount as well as other types of abnormal eye conditions must be handled for each child individually by a professional eye examination, i.e., one performed by either an ophthalmologist or an optometrist.

development of fine muscle coordination for rotating the eyes (similar to finger coordination.)

Just as girls are usually ahead in other phases of growth, so they are in eye development. If we observe a reading clinic or retarded reading group we will see that there is a predominance of boys. This fact is not due only to varying interests and psychological differences, although these are undoubtedly related factors. A very important factor here is their maturity at the time certain tasks were introduced to them. Visual development is a part of or related to the whole growth and development of the child.

Early childhood is a critical period. Educational and visual problems can often be prevented by controlling our natural desire to start children reading from books in kindergarten. Formal reading classes should not be required at this age.

In the kindergarten child, direction sense, particularly the left to right progression in seeing words, is not firmly established yet and the appearance of letters and numbers has not become strongly fixed. As a result, some reversal of numbers and letters, even mirror writing (starting at the right and proceeding across to the left, making all letters and numbers backwards) is to be expected. Labels in large print, large chart stories, printed samples of his own name, etc., can be readily used.

If he makes an error, criticism or scolding will only add to his confusion as he is not yet able to recognize his error. The reversals of either letters or numbers may be corrected by patient and encouraging guidance —that is, retraining of the small child as he practices the copying of letters or numbers.

While the reversal problem and mirror writing are not the result of vision difficulties, they are associated with and in most cases originate from improper eye use due to immaturity and confusion. Older children have been known to continue reversing intentionally because they enjoy the attention they get from this "dramatic" difference from other children. It is sometimes used as an excuse for not learning to read. These are rare instances as most children want to conform. However, these children should have a careful evaluation of their general condition including a careful examination of their eyes.

Suggestions for Teachers

OBJECTIVES

Understand how our eyes help us
Realize that we depend on our eyes all the time
Recognize the need to take care of our eyes
Cooperate in vision screening tests

Our Eyes

We have a sense of sight. (1) Draw a large eye on the chalkboard and discuss eyes and their care. Reference books are suggested for the teacher to read to the children, then discuss. (2) Two puppets, made from mittens having movable eyes may be used during discussion. It is suggested that the teacher name the puppets, e.g., Mr. and Mrs. Goodnight.

Our eyes help us see. (1) The teacher may make two boxes. One a "seeing box" (a box decorated as a face with big eyes). In this are placed different articles that help us see, such as: magnifying glass, binoculars, eye glasses, flashlight, etc. The children are allowed to experience "seeing" with the various glasses in bright light, dim light, no light. Then they tell about "seeing" in the different situations. (2) In the second box, the "feely meely box," are placed various objects for the child to try to identify without "seeing" such as a nut, a rock, or a ball. The children are allowed to reach in the box, which has an opening in the top, feel the objects and guess what they are, then to look and see if they can identify with the help of their eyes. Discuss how much easier it is with the eyes.

We must protect our eyes. Discuss rest and sleep, safe play, how to carry scissors, pencils, etc., and vision screening tests (play the E game).

B. Early Elementary (1st, 2nd, and 3rd Grades)

The eyeball continues to grow and by the age of 6½ or 7, the child should be able to see larger print, usually 12 point type.* The child now begins to use his peripheral vision and reads phrases rather than only segments of a line.

For the few children showing any reversal tendencies, good educational management suggests they may be helped by patient supervision to establish a left to right progression in both reading and writing. It may be helpful to place a line, mark, or star at the left side of the page to indicate where they should start. Following a line with a ruler or finger may be helpful and should not be discouraged.

The confusion of such words as "saw" and "was" usually indicates that a child needs more emphasis on phoentic patterns in reading in contrast to seeing the word as a whole. He is not necessarily in need of a pair of glasses. A professional eye examination to rule out possible abnormalities, however, is always advisable if a problem persists.

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*This footnote is set in 12 point type.

At about 8 years of age, the eyeballs of most children will become fully developed and binocular vision is fixed, allowing them to see normally.

The third grade is usually a happy time in the life of most children. Most of them catch up and are able to overcome the handicaps of immaturity which had beset them earlier. Unfortunately, some will continue to be handicapped because of the negative self-concepts developed as a result of their own immaturity in dealing with a task for which they were physically not ready.

Strangely enough, at this time new problems arise. As print becomes smaller, the reading load becomes much heavier, and more vision trouble may be encountered. Careful observation of the child for signs of eye trouble and vision screening continues as an essential task for the teacher. For, in this period, some children may become nearsighted and for the first time show a vision problem. As their distance vision becomes inadequate, these children will spend more and more time with books, and may avoid those games and activities which require distance vision. They frequently are the best students, but we do not realize that the reason is that they are concentrating on what they can do well and are avoiding normal and versatile activities of childhood. At about this time, a professional eye examination may show that a few children no longer need glasses to correct farsightedness.

Television viewing has no harmful effect on the eyes but should not substitute nor interfere with school and recreational activities. It is suggested that the viewers be at least from 6 to 8 feet from the screen and that they frequently look away from the screen or change their activity.

Suggestions for Teachers

OBJECTIVES

- Understand more about the eyes and vision and what they do for us
- Realize our dependence on sight
- Recognize the need to take care of our eyes and vision
- Learn rules for protecting eyes from injury and infection
- Learn why we have vision screening
- Understand why some people have to wear glasses to help them see
- Be willing to wear glasses and aids if needed
- Recognize the need for good food to help us grow and see better

Function of the Eye

We use our eyes to help us learn. (1) Explain that we need light to see. (2) Light rays enter the eye through the lens which bends the light to form an

image on the back of the eye. The brain tells us what the image is. (3) Have children tell about a recent trip to the zoo, a farm, the fire station, or a supermarket. What impressions would they have if they could not see? Ask the children to recount what their eyes told them about safety and the rules that use the word "look" (crossing the street, throwing a ball, seeing the animals). (4) Play "what can you see in 1 minute?"

Vision is one of our most valuable senses. Blindfold test—play "pinning the tail on the donkey."

Animals need good eyes too. (1) Observe at the zoo or farm how eyes of animals differ or show pictures of eyes of different animals. (2) Talk about kinds of animal eyes (some see in the dark, fish have no eyelids).

Protection and Care

We must care for our eyes so that they will work for us. (1) Ask children what happens to their eyes when they go to sleep. (2) Talk about what they have learned about food and nutrition. Show pictures of the foods we should eat every day and indicate which ones are specifically good for eye health. (3) Have children think about play activities which might injure eyes. (The most frequent cause of eye injuries in children comes from blows, sharp objects, falls, fireworks, and missiles.)

Eye safety rules help us protect our eyes and prevent eye accidents. (1) List some eye safety rules and take copies home. (2) Have children cut out and mount pictures of dangerous "playthings" for bulletin board. (3) Ask school nurse to talk to the class about care of the eyes, first aid, and the importance of reporting injuries for first aid treatment.

We must plan our activities to avoid eye fatigue. (1) Discuss the importance of proper lighting on books and newspapers and the importance of resting eyes often to avoid eye fatigue. (2) Discuss why not to watch television for long periods. (3) Discuss rules for avoiding eye fatigue.

Vision Screening

A specially trained person (such as the school nurse, teacher, or volunteer) tests our vision to find out if we can see well. (1) Explain the vision screening tests, how and why they are done. (2) Show the Snellen E chart and demonstrate its use. (3) Explain and demonstrate the use of the occluder.

We should have a vision screening test every year. (1) Discuss what students have learned about how children grow pointing out that children's eyes grow as their bodies grow and therefore their vision must be tested each year. (2) Show film to stimulate child's interest in eye care. (3) Talk about differences in physical development of children and explain growth of the eye and the development of refractive errors. (4) Have children discuss the reasons for the classroom vision testing program. Children with vision problems may not know they cannot see as well as others.

A vision screening test at school is different from a professional eye examination. Talk about the differences between a vision screening test and the professional eye examination. (Perhaps a child who has had a professional eye examination can tell about it.)

C. Upper Elementary (4th, 5th, and 6th Grades)

The eye development of the fourth and fifth grade child is usually stabilized. Some new cases of eye difficulty will occur but those who have progressed to this age with few or no eye problems will probably continue to get along fairly well. Eye injuries, resulting from unsafe equipment, games or play activities, bows-and-arrows, and BB guns occur more frequently, however.

By the sixth grade, some children will be moving into the period of rapid growth and development which is sometimes accompanied by sudden changes in vision. This growth spurt is most frequent among girls from 10 to 13 and boys from 12 to 15. A child's vision may change from normal to significant nearsightedness within a few months. Such a rapid change in his ability to see may be an emotionally upsetting experience to a child. He may become withdrawn and extremely sensitive or he may exhibit signs of tension, frustration, and rebellion.

Physicians advise that these eye changes, in most cases, cannot be prevented. However, if a complete eye examination is secured soon after the onset of this condition, and if glasses will correct the nearsightedness, serious personality damage can be prevented. Consequently, all children should be watched closely during this stage for changes in scholastic aptitude and personality changes such as those mentioned above. Observation for signs of poor eye habits should also continue.

In the upper elementary years print becomes smaller and laboratory and programmed learning more common so eye use becomes almost con-

stant and rest periods become less frequent. Difficulty in using the two eyes together, caused by a small degree of muscle imbalance at earlier grades, may now cause considerable eye and body fatigue. Tension, irritability, and misbehavior often result. A simple adjustment in the school day's activities may relieve these symptoms for some children. Others may need to be referred for a professional eye examination. After an eye examination, glasses may be prescribed or, in some instances, although a small defect is present, the recommendation may be preferential seating rather than glasses.

Suggestions for Teachers

OBJECTIVES

- Understand the general anatomy and function of the eye
- Know the kinds of visual defects and their treatment
- Understand the importance and value of periodic vision screening tests
- Understand the relationship between general health and eye health
- Develop health habits and practices that contribute to care of the eye and improved vision, including good nutrition

The Parts of the Eye

The eye is the organ of sight, a part of the nervous system. Using a model of an eye, point out the structure of and discuss function of cornea, iris, lens, choriod, sclera, retina, aqueous humour, vitreous body, optic nerve, eye muscles, blood vessels.

How We See

The process of seeing starts with reflected light. The light waves go through the pupil of the eye to make an image on the retina. The optic nerve sends messages from the retina to the brain about the image and the brain gives meaning to what the eyes see. (1) Show film demonstrating reflection and refraction of light. (2) Suggest showing film "Our Eyes and How They Work" and then discussing how we see, how we know what we see, and what is "normal" vision?

Nearsightedness (Myopia) and Farsightedness (Hyperopia)

Some eyes have irregularities of size or shape which cause refractive errors and poor vision. (1) Using drawings on the board, demonstrate how a lens focuses rays of light on the retina. (2) Demonstrate refractive errors.

Nearsighted individuals can see nearby objects well, but cannot see faraway objects clearly. A farsighted individual can see faraway objects clearly, but not nearby objects. Explain nearsightedness and farsightedness.

Proper eyeglasses can make the nearsighted individual see normally. Use convex and concave lenses to illustrate how light rays can be concentrated or diffused. Compare these to the lens of eyeglasses.

Color Discrimination (How We See Color)

Color discrimination is our ability to distinguish one color from another. (1) Have the children give examples of color. (2) Explain what color tells us: in nature; in safety; in our clothing and surroundings. (3) How does color give us information.

Varying shades of a color are visible depending on the presence and intensity of light. Objects have slightly different colors in bright sunlight, daylight, and artificial light. (1) Darken the classroom and have children note the change in the color of various objects. (2) Have children go into a dark room (closet or lavatory) and note that they cannot see the color of their clothing or the surroundings in complete darkness.

Color is a property of light of moderate or high intensity. The luminous spectrum (visible light) is but one part of the whole spectrum of radiation. Some parts of the spectrum of radiation may be harmful to our eyes. (1) Demonstrate ignition of a piece of paper by focusing sunlight through a magnifying glass. (2) Use a prism or drawing to show the visible spectrum, pointing out that the red rays are the longest, the violet the shortest.

The sight-receiving cells in the retina that "see" color are the cones. When light falls on an object, some of the light is reflected, some is absorbed. The color that we see is the result of the reflection and/or absorption of light rays. White light is a mixture of light rays of all colors. A red object absorbs light rays of all colors except the red which is reflected to the cones of the retina producing the sensation of the color red in the brain. Demonstrate the three primary colors (blue, green, red). Explain that all colors can be produced by combining pairs of primary colors in different proportion.

Defects of Color Perception (Color Blindness)

Some people are unable to see colors normally. (1) Discuss color discrimination deficiencies and the fact that some people do not see all colors combined from the primaries. *Total color blindness* is extremely rare; the person has complete lack of color discrimination and sees all colors in shades of gray. In *partial color blindness* faulty recognition of colors is the only characteristic symptom. A person with red-green deficiency sees these col-

ors as yellow, while the ability to see blue is normal. The visual acuity of individuals with total color blindness is low, usually 20/70 to 20/200. Visual acuity in partial color blindness is generally better. (2) Explain that color blindness is not a disease, but a defect of vision inherited from the mother who is rarely color blind herself. (3) Discuss the hazards of color blindness.

Color Discrimination Tests

Our ability to distinguish colors accurately can be determined by an appropriate standardized screening test procedure. Demonstrate the Hardy-Rand-Rittler Pseudoisochromatic Plates Test and the Ishihara Test recommended for use in color discrimination tests in schools. Explain the importance of correct illumination for the test.

Visual Acuity Tests

The distance acuity screening procedure is used to test visual acuity. (1) Demonstrate the Snellen test and explain how it is based on a standardization of visual acuity. (2) Relate symptoms of eye fatigue to the need for an eye examination.

A vision screening test detects probable decreased visual acuity. A professional eye examination may confirm this and identify the cause of the decreased visual acuity. Draw on a child's experience of having an eye examination.

Efficient use of vision requires correction to normal by the wearing of glasses. (1) Explain that the wearing of glasses helps the eye perform the normal function for which it was intended. (2) Explain that having one's vision tested and wearing eyeglasses, if needed, are important steps in growing up.

Eye Difficulties

An eye specialist should be consulted periodically to check for any eye difficulties. Discuss the following symptoms of possible eye difficulties: (a) frowning, rubbing eyes, attempting to brush away a blur, (b) tilting or thrusting head forward when reading, (c) having difficulty or tiring while doing close work or reading, (d) blinking, or tearing when doing close work, (e) sensitivity to light, (f) red-rimmed and encrusted eyelids; swollen and watery eyes, (g) reluctance to participate in games requiring distant vision, (h) complaints of nausea, dizziness, or headache following close work.

For Eye Injuries

We should guard our eyes against accidents. (1) Review the causes of eye injuries in the K-3 grade curriculum. (2) List various ways of preventing eye injuries such as the use of safety glasses in certain hazardous occupations.

Eye Health and General Health

The health and functioning of the eye is dependent upon the general state of health. (1) Relate signs of general health and fatigue to good and poor eye health. (2) Discuss the rules for good general health, including a well-balanced diet, adequate rest and exercise, good habits of personal cleanliness, and medical care for illness.

A disease that affects the body may affect the eye or the eye may indicate the presence of a general disease. Use an eye model to demonstrate the anatomy of the eye and its relation to the sinuses, blood vessels, brain, nose, etc.

D. Early Adolescence (7th, 8th, and 9th Grades)

In these grades, scholastic, athletic, and social demands upon vision increase. Often textbook print is smaller and more homework and reading become necessary. Students are more aware of the need for good vision as they participate in activities more demanding on vision. These activities do not actually produce vision difficulties, but by placing more demands upon the visual system, conditions which otherwise might be insignificant may produce discomfort and become problems.

At this age, rest and nutrition are often inadequate tending to produce inadequate body performance. The period of rapid growth mentioned in the discussion of children in the 4th, 5th, and 6th grades may start or become enhanced for some children at this age. During these grades myopia may be more prevalent or become more pronounced. Professional evaluation and care should be provided. Eye injuries occur far more often. Some of the more frequent causes are chemical burns, wounds from gunshot and air rifles, athletic bruises, and others resulting from carelessness.

Teachers of these grades should encourage good health and safety practices as well as good visual environment. By maintaining optimal seeing conditions in the classroom, teachers can help children make the best use of their vision and teach good habits. Teachers of this age child, particularly should keep in mind that, if glasses have been prescribed, the student should be encouraged to wear them.

Older students are often self motivated to obtain eye care for the sake of appearance and visual comfort. Ptosis (drooping eye lid) and strabismus (crossed eyes) are preferably treated in earlier years but may go untreated until the adolescent or young adult is personally concerned. In the secondary school grades, the use of contact lenses is more prevalent, particularly with girls. Proper use and care of contact lenses should be stressed.

As emphasized in the earlier years, whenever evidence of poor vision occurs, even though glasses are worn, all students should be referred for professional eye examinations.

Suggestions for Teachers

OBJECTIVES

- Develop an understanding of visual acuity
- Understand the relationship between light and vision
- Develop an appreciation of the value of good vision to productive living
- Learn the types and significance of visual disorders
- Learn to appreciate some of the current research and techniques available to alleviate causes of visual disorders
- Become aware of the medical and nonmedical personnel and services available to assist the individual with visual problems.

Plan for Healthful Living

Develop habits which allow you to enjoy better health. Discuss the role of periodic health examination, nutrition and diet, sleep, television, study, sports, reading, and driving.

The Eyes and How They Function

The eye is a sense organ which receives visual stimuli to be transmitted to the visual center of the brain. (1) Show the films "Why We See Like Human Beings" ("Our Eyes and How They Work," and "Vision Problems and Eye Care"). Follow by a review and discussion of the anatomy of the eye and the role each part plays in vision. (2) Point out the interrelationship of the parts of the eye that are necessary for us to see. (3) What part does psychology and experience play in the visual stimuli to the brain?

Visual Development

Hereditary potentials control vision and learning how to see and what to see. Have students observe some common objects: (e.g., a flower, a picture, and a pencil) and describe what they see: (color, relationships of parts, size, regularities, etc.). Are the descriptions alike? Why are there some differences?

Visual Acuity

Visual acuity is the ability to distinguish fine detail. It means sharpness of vision (see Glossary). Distinguish between visual acuity and visibility.

Many factors affect visual acuity even in normal vision. These factors include: angle of retinal stimulation, light intensity, distance to the object to be seen, time of retinal stimulus, and contrast with other nearby object or background. (1) Set up situations to test the factors which affect acuity. Have students experience these and describe their experiences. (2) Plan a field trip to office of an optician, ophthalmologist, or optometrist so small groups of students may learn how acuity is measured and corrected.

Measurement of Acuity

The Snellen chart is one of the most common screening devices for measuring visual acuity. (1) Students may report on the history and development of the Snellen chart. (2) What does vision "screening" mean? What are some of its limitations? What is its main function? What are the school criteria?

Retina

The light-sensitive retina lines about two-thirds of the back part of the internal eyeball. The retina is essential for vision to take place—like film in a camera. Why is the retina essential to vision?

Blind Spot

The "blind spot" is that point where the optic nerve enters the eye. It is insensitive to light stimulation. Using a kit of vision experiments, demonstrate the blind spot and have each student find his own blind spot.

Eye Defects

The normal eye brings parallel rays of light to a focus on the retina. Make a list of common eye defects. Distinguish between those which are due to structural defects and those due to disease.

Refractive Errors

Refractive errors are defects of vision that are caused by irregularity of the size, shape or function of the eyeball, lens, or cornea. They include myopia and hyperopia. (1) Use drawings to illustrate normal, myopic, hyperopic eyes. (2) Show films: "Why We See Like Human Beings," ("Our Eyes and How They Work" and "Vision Problems and Eye Care").

Eyeglasses compensate for refractive errors but do not cure them. (1) For illustrations, refer to "Health and Safety for You" and "Modern Health" (App. C). (2) A student report on the history of spectacles will indicate the great strides that have been made since the inception of the idea.

Myopia (Nearsightedness)

The myopic person sees distant objects out of focus. Does a local eye specialist have a collection of corrective lenses that may be brought to school to be discussed and studied?

Myopia may be caused by heredity, disease, growth, or function and should be treated since it may influence one's personality and posture. Make a list of activities or situations in one's life which may be influenced by refractive errors.

Hyperopia (Farsightedness)

A person with hyperopia sees distant objects clearly, but near objects are indistinct. Eye specialists do not always find it necessary to prescribe eyeglasses for hyperopic individuals. (1) Distinguish between the various kinds of refractive errors. Which are most common among young people? Why? (2) Do eye exercises cure eye defects? Explain. (3) Have students analyze the specific kinds of errors in judgment which might be made by a person with uncorrected refractive errors while driving a car.

Presbyopia

Presbyopia is the condition in which the crystalline lens becomes less elastic with age, causing failure of the eye's near focusing power. How is presbyopia similar to hyperopia? Explain how they differ.

Astigmatism

In astigmatism, there is defective curvature of the refractive surfaces of the eye preventing sharp focus either near or distant. Demonstrate astigmatism by referring to the textbook "Your Health and Safety."

Strabismus

Strabismus is the inability to attain binocular vision, because the eyes are not simultaneously directed to the same object. Why should strabismus have professional eye care? In strabismus the eyes seem to turn inward or outward, upward, or downward independently. Describe how dim vision in one eye may result from untreated strabismus.

Eyeglasses and Corrective Lenses

Eyeglasses should be prescribed by either an ophthalmologist or an optometrist. Prescription lenses are ground to the specifications of a specialist and are worn to improve vision. (1) Describe conditions under which each kind of lens may be most useful or helpful. What advantages does one kind of lens have over others? (2) Compare lenses with each other and relate to the refractive errors that they may be used to correct. Identify the types of lenses worn by students in the class. Discuss choice of frames, contact lenses, sunglasses, low vision aids. (3) Invite an optician or optometrist to class to discuss and demonstrate the evolution of corrective lenses.

Other Common Diseases of The Eye

Some of the common diseases of the eye are glaucoma, cataract, and conjunctivitis. (1) Distinguish between each of the various kinds of eye diseases relative to: cause, prevention, nature, and dangers to vision. (2) Discuss with school nurse or public health nurse the cause and spread of conjunctivitis (pink eye).

In every case of cataract all or part of the lens becomes opaque. The etiology of cataract is not always known. Discuss methods used in treating cataracts.

Early detection and treatment of glaucoma are essential. (1) How is glaucoma detected? (2) What are the general signs of early glaucoma? (3) How does acute glaucoma compare with chronic? (4) Have students investigate glaucoma screening programs in the community. (The local health department is a good resource or state society for the prevention of blindness.) (5) Have students poll their parents to find out how many have been tested for glaucoma.

Common Injuries to the Eye

The leading cause of loss of sight among adolescents is injury to one or both eyes. (1) List situations most likely to cause partial or complete loss of sight. (2) List ways teenagers may help prevent eye injuries to themselves and to others (at school, home, play). (3) Prepare short talks on eye safety for other classes, shops, or laboratories, and for the PTA. (4) Discuss what parents should do to protect their children's eyes.

Eye Care and Safety

Various professions have responsibility for eye health. (1) Physicians—[family physician, ophthalmologist (oculist), optometrist, pediatrician,

surgeon, neurologist, psychiatrist]; (2) Public Health Optometrist and School Health Personnel—(physician, nurse, health educator, dentist, dental hygienist, engineer, vision consultant, vision screening technician); (3) Teacher—(classroom, school nurse-teacher, science, health education, visually handicapped). Discuss the individual's responsibility for his eye health and safety, and the school's responsibility for eye health and safety.

Qualified eye specialists should be consulted about any eye problems. (1) Discuss these specialists regarding training, qualifications, etc. (2) Make a list of occupations which deal in some way with the eyes. Include those related to safety as well as those who treat eye problems.

Driving

Good vision is essential to good driving. (1) Prepare talk on how to use your eyes while driving. (2) Investigate the slogan, "If you are driving, don't drink," and discuss it in terms of vision. (3) Investigate driver licensing laws in your state and evaluate them regarding vision requirements.

Illumination

Adequate lighting is necessary to clear visibility. (1) Find out if there is a relationship between high crime rate and inadequate street lighting in cities. Does your City Planning Board consider adequate street lighting? (2) Investigate different lighting methods: incandescent, fluorescent, cold cathode. (3) Discuss use of lighting and color for various effects.

CHAPTER 5

SAFEGUARDING VISION IN SCHOOLS

A. School Safety Policies and Standards

Serious accidents occur in schools throughout the country involving visual damage and loss of sight so that educators are called upon to teach the obvious—the high value of unimpaired vision and the means of protecting and maintaining such vision. According to Richard P. Gousha, State Superintendent of Public Instruction in Delaware, "Negligence" is the most common reason for eye accidents. (DPISDel, 1967) For example, neglect of immediate care of eye injuries. Eye damage and even blindness have resulted from the flick of a rubber band or a paper clip fired from a rubber band; untreated eye injuries such as a blow in the eye with complaint of blurred vision or lack of attention to a child's complaint of a foreign body in the eye can result in inflammation of the sclera or a damaged cornea.

Workshop and laboratory facilities in today's educational institutions enable students to gain a variety of practical experiences. As a result students, instructors, and visitors are exposed to hazardous situations which could result in serious injury to the eyes unless adequate protection is provided. Prevention is the key.

Preventive Safety Program

Dr. Alma Nemir (1970) points out in her text on the school health program that the development of the preventive safety program involves all school personnel. They share in developing a program that has these major components: administration (planning, organizing, directing, supervising, budgeting, reporting, and evaluation); instruction (curriculum designs for integrating and correlating safety in all school areas); and protection

All references cited in this chapter are listed in Section 5 of the Bibliography, Appendix B at the end of this manual.

(engineering-enforcement provisions to control the school environment). A preventive safety program should also involve a study of the school accident records in order to evolve plans for building safety, traffic safety, placement of responsibilities, and school community relationships.

Rules, regulations, and procedures for controlling accidents should be developed by faculty and students to assure wide acceptance.

The designation of a chief school safety officer or safety coordinator has been an invaluable contribution to the greater safety for the schools. With the assistance of safety councils or committees, and in and out-of-school support agencies, such leadership will assist administrators in the tasks of establishing successful programs. Student participation in safe living is essential to a program. Various types of councils and clubs may be organized. In the elementary grades, classroom and school safety councils have definite roles. Later, specialized phases are stressed through such organizations as those whose interest is bicycle, automobile, or shop safety. In the secondary schools, there may be a student traffic court and committees responsible for license requirements including vision, traffic regulations and parking permits, for planning programs and publicity on safety, and for reporting and analyzing accidents.

Responsibilities for the Safety Program at School

Emphasis is placed on the team approach in handling school safety problems. All professional teaching personnel and nonteaching individuals have a responsibility, as does the student at each age level. The National Safety Council has an excellent slogan: "Make safety their responsibility too." Students are taught to assume responsibility for their own as well as everyone else's safety—the "Golden Rule." The danger zones in the lower grades are playgrounds. During unsupervised play, children may throw sand or run with sharp sticks in their hands; in gymnasiums, sharp objects may protrude from walls or from play equipment that is in ill repair, or the child may be hit in the eye by an object thrown by another; in school corridors and on steps, the child may carry sharp pointed scissors or pencils and in a fall jab his eye, or the eye of another child while running. For adolescents, the gymnasiums, athletic fields, and laboratories are problem areas. Young adults in college have a frequency and severity of accident experience which exceeds that of noncollege youth in the same age bracket, according to Dr. Nemir.

The National Safety Council (1968) reports that 67% of all school jurisdictional accidents involving boys, and 57% involving girls, occur in the areas under the supervision of physical education teachers, athletic coaches, and recreation leaders. Greater attention on their part to the anticipation and prevention of accidents and control of injury is therefore imperative.

Obviously, vigorous movement activities possess inherent dangers not always readily apparent. Professionals must be aware of the hazard of vigorous movement activities and reduce needless risk in any physical education activity without unduly stifling the spirit of adventure.

Continuous research in accident and injury control strives to furnish new solutions to current accident problems in schools. The emotional/psychological climate which prevails in sports activities needs further study also, so that human behavior may be modified to acceptable levels of risk acceptance. The challenge we face is to develop in our youth a lifelong ability to function optimally. The degree of safety which we will achieve will largely depend upon the degree to which we are determined to achieve it.

General School Safety Policies

The school administrator has responsibility for the development of a comprehensive school safety program. His attitude toward and knowledge about safety will determine the effectiveness of the program. Policies developed by the American Association for Health Physical Education and Recreation to serve as guides toward the implementation of actions in achieving this goal include the following which are related to eye safety (AAPHER, 1968).

PLANNING

1. In establishing policies, participation should be invited of all persons and groups concerned; students, teachers, administrative staff members, aides, school employees, board of education members, parents, representatives of community or governmental groups, and other interested citizens.
2. A faculty - student committee should be organized to advise on accident prevention and ways of achieving safety.
3. Provision should be made for the use of advisory services from professions such as medicine, law, insurance, engineering, and safety, to help in planning and evaluating accident prevention procedures.
4. All schools should have a comprehensive school safety program, including safety services, safety education, and a safe environment.
5. Schools should have an accident reporting and investigating system.
6. Administration has the responsibility for adherence to provisions of school law, state and local laws, codes and ordinances, and contractual agreements.
7. Adequate insurance programs should be maintained by all schools, with details of the coverage and limitations understood by all school personnel.
8. Recommendations for building requirements and review of plans should involve teachers and other

school personnel. Thus, architects and engineers, in developing safe facilities, can be made aware of potential hazards recognized by an experienced staff.

9. Every school should have a well-defined plan for handling emergency care problems, including parental approval for transportation and emergency medical care. Such arrangements for emergency care and transportation should be made in writing at the beginning of the school year.

ORGANIZATION AND PROGRAM

1. Each school should designate a school safety coordinator to direct the total accident prevention program.
2. Provision should be made for the development of a comprehensive safety education curriculum.
3. All safety rules and regulations should be included in the school's administrative handbook.

CONTROLS

1. All students and staff members should be familiar with their responsibility to report immediately any hazardous condition, dangerous activity, property damage, or injury, in accordance with established procedures.
2. All school personnel should comply with rules and regulations governing safe practices and procedures.
3. Close supervision should be provided wherever students participate in potentially hazardous activities.
4. All safety rules governing the use of facilities, equipment, and supplies should be conspicuously posted.
5. Information about the health status of students and school personnel should be made available to appropriate staff.
6. Approval from a physician, with notification of any activity limitations, should be obtained before any student is readmitted to school after a serious injury or illness.
7. Only equipment and supplies that meet highest standards of safety should be purchased and used by schools.
8. Students should be required to make proper use of protective equipment in hazardous activities.
9. Equipment, devices, materials, or animals which may be potentially dangerous should not be allowed on school property without prior approval of appropriate school officials.

PERSONNEL

1. All personnel involved in the operation of the school program should have an understanding of their specific roles in accident prevention.
2. Noninstructional personnel of the school, such as bus drivers, recreation aides, and custodians, should be qualified to carry out the eye safety aspects of the specific assignments.
3. Teacher training institutions should make provisions for preservice education in safety for prospective teachers and administrators.
4. School personnel should be informed of new findings and best practices in accident prevention and injury control.

EVALUATION

1. A system should exist for appropriate inspections and evalua-

tion of facilities, equipment, and buildings, as a basis for improvement.

2. There should be a system of accident investigation and reporting, to provide information for evaluation.
3. There should be a continual updating of accident prevention policies, procedures, and practices.
4. Analysis of accidents, injuries, and damage should be made and periodic summaries of such data should be distributed to appropriate individuals.

Eye Safety in Laboratories and Shops

In junior and senior high schools most eye injuries occur in the industrial arts shops and laboratories. The high incidence of these injuries and the increasing number of lawsuits against teachers for negligence, with damage awards running into six figures, have prompted the development of eye protection programs in schools. Accident prevention measures, must include the proper selection, use, and sanitizing of safety eyewear. The first state law for eye protection in schools became effective in Ohio in August, 1963 and required industry-proved eye protection for all students and teachers using laboratory and shop facilities. Thirty states now have such a law in effect making the following requirements:

> Every pupil and teacher in any public school participating in any of the following courses:
> (A) Vocational or industrial arts shops or laboratories involving experience with:
> 1. Hot molten metals;
> 2. Milling, sawing, turning, shaping, cutting, or stamping of any solid materials;
> 3. Heat treatment, tempering, or kiln firing of any metal or other materials;
> 4. Gas or electric arc welding;
> 5. Repair of servicing of any vehicle;
> 6. Caustic or explosive materials;
> (B) Chemical or combined chemical physical laboratories involving caustic or explosive chemicals or hot liquids or solids; injurious radiations, or other hazards
> is required to wear industrial quality eye protective devices at all

times while participating in such courses or laboratories. A board of education may furnish such devices for pupils and teachers, and shall furnish such equipment for all visitors to such classrooms or laboratories. A board of education may purchase such devices in large quantities and sell them at cost to pupils and teachers.

Selection of protective eyewear. Some school systems prefer to supply plano (noncorrective) safety eyewear to students and teachers without cost, just as they do other educational materials; others purchase eye and face protective devices which they sell at cost to students for a moderate fee. Safety eyewear should be required for visitors to the educational area listed and should be provided without charge.

The term "industrial quality safety eyewear" refers to devices which meet or exceed *all* the requirements of the *American National Standard Practice for Occupational and Educational Eye and Face Protection. Z87. 1-1968,* or later revisions thereof, approved by the American National Standards Institute, Inc. The ANSI Z87 standard is primarily intended to provide guidelines for manufacturers of safety eyewear.

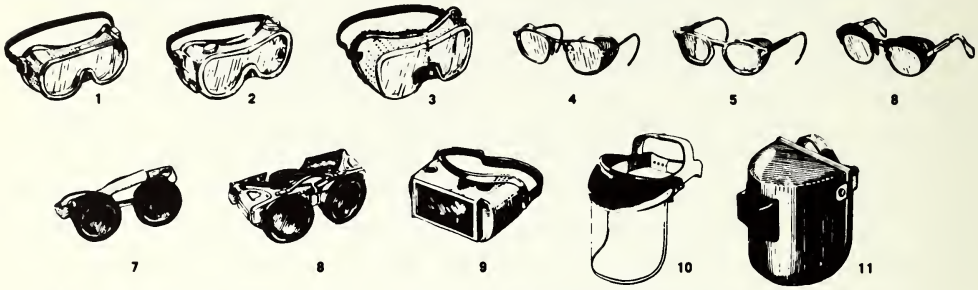
It is recommended that for purchase specifications school safety eyewear clearly indicate that, except for visitor safety eyewear, all devices to be bid upon must comply *in every respect* with the ANSI Z87 standard. A further safeguard against purchase of substandard devices is to require all successful bidders to certify on their business letterhead that safety eyewear being furnished is in compliance with the ANSI Z87 standard. These recommendations are aimed at insuring maximum eye protection for students and teachers, and legal protection for school administrators, boards of education, and the community itself.

Personal eyeglasses should not be considered as a substitute for industrial safety glasses unless the professional who prescribed or dispensed them certifies compliance with the ANSI Z87 standard. Many activities call for specialized protective devices, as recommended in the selection chart (see table below). Safety eyewear must be required, particularly for all students and teachers in laboratories and shops who wear contact lenses.

Care of safety eyewear. When a person is assigned protective equipment, it is recommended that this equipment be cleaned and disinfected regularly and before use by another person.

Disinfection Procedure. Clean all surfaces thoroughly with soap or a suitable detergent and warm water. Rinse carefully and completely immerse the eye protectors for 10 minutes in a distinfectant solution in a strength specified by the manufacturer at a room temperature of 68°F.

Recommended Eye and Face Protectors for Use in Industry, Schools, and Colleges



1. **GOGGLES,** Flexible Fitting, Regular Ventilation
2. **GOGGLES,** Flexible Fitting, Hooded Ventilation
3. **GOGGLES,** Cushioned Fitting, Rigid Body
*4. **SPECTACLES,** Metal Frame, with Sideshields
*5. **SPECTACLES,** Plastic Frame, with Sideshields
*6. **SPECTACLES,** Metal-Plastic Frame, with Sideshields
** 7. **WELDING GOGGLES,** Eyecup Type, Tinted Lenses (Illustrated)
7A. **CHIPPING GOGGLES,** Eyecup Type, Clear Safety Lenses (Not Illustrated)
** 8. **WELDING GOGGLES,** Coverspec Type Tinted Lenses (Illustrated)
8A. **CHIPPING GOGGLES,** Coverspec Type, Clear Safety Lenses (Not Illustrated)
** 9. **WELDING GOGGLES,** Coverspec Type, Tinted Plate Lens
10. **FACE SHIELD** (Available with Plastic or Mesh Window)
11. **WELDING HELMETS

*Non-sideshield spectacles are available for limited hazard use requiring only frontal protection.
**See appendix chart "Selection of Shade Numbers for Welding Filters."

APPLICATIONS		
OPERATION	**HAZARDS**	**RECOMMENDED PROTECTORS:** Bold Type Numbers Signify Preferred Protection
ACETYLENE–BURNING ACETYLENE–CUTTING ACETYLENE–WELDING	SPARKS, HARMFUL RAYS, MOLTEN METAL, FLYING PARTICLES	**7, 8, 9**
CHEMICAL HANDLING	SPLASH, ACID BURNS, FUMES	**2,** 10 (For severe exposure add 10 over 2)
CHIPPING	FLYING PARTICLES	**1, 3,** 4, 5, 6, **7A, 8A**
ELECTRIC (ARC) WELDING	SPARKS, INTENSE RAYS, MOLTEN METAL	9, **11** (11 in combination with 4, 5, 6, in tinted lenses, advisable)
FURNACE OPERATIONS	GLARE, HEAT, MOLTEN METAL	**7, 8, 9** (For severe exposure add 10)
GRINDING–LIGHT	FLYING PARTICLES	**1, 3, 4, 5, 6,** 10
GRINDING–HEAVY	FLYING PARTICLES	**1, 3, 7A, 8A** (For severe exposure add 10)
LABORATORY	CHEMICAL SPLASH, GLASS BREAKAGE	**2** (10 when in combination with **4, 5, 6**)
MACHINING	FLYING PARTICLES	**1, 3, 4, 5, 8,** 10
MOLTEN METALS	HEAT, GLARE, SPARKS, SPLASH	**7, 8** (10 in combination with **4, 5, 6,** in tinted lenses)
SPOT WELDING	FLYING PARTICLES, SPARKS	**1, 3, 4, 5, 6,** 10

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Remove protectors from the solution and suspend in a clean place for air drying at room temperature, or with heated air. Do not rinse because this will remove the residual effect.

Ultraviolet disinfecting equipment may be utilized in conjunction with the washing procedure above, when such equipment can be demonstrated to provide comparable disinfection. Protectors which need extensive cleansing should be disassembled to the extent possibly without tools, prior to the washing and disinfection procedure, and defective parts replaced.

Maintenance. It is essential that the lenses of eye protectors be cleaned daily. Dirty lenses can cause eye fatigue and contribute to accidents. Pitted or scratched lenses reduce vision and seriously reduce protection, and should be replaced immediately. Check headbanks regularly and replace when worn-out or when they do not hold the eye protector in proper position.

Storage. To prolong the life of protectors, they should be placed in individual containers and then stored in a clean, dust-free storage cabinet between periods of use.

Issue and use. Safety eyewear are personal items and should be used exclusively by the person to whom they are issued. When reissued, the protectors should be thoroughly cleaned and distinfected in accordance with the recommended procedure.

Recommendations

—that only protective lenses of impact-resistant glass or plastic be used in eyeglasses and sunglasses for the general public;

—that all protective lenses be mounted in nonflammable frames designed to hold them securely under impact;

—that individuals with sight in only one eye use protective spectacles throughout their waking hours;
and,

—that persons engaging in home crafts, sports, or hobbies which involve hazards to vision regularly use appropriate safety eyewear, even over their personal safety glasses.

These recommendations are based on thousands of case histories in which eyesight was saved by impact resistant spectacles or other forms of safety eyewear, and are supported by over a quarter-century of successful industrial application.

The National Society for the Prevention of Blindness recommends only those impact-resistant lenses and other protective eyewear which meet or exceed current American National Standards Institute (formerly USA Standards Institute) quality and performance standards: Z80 (nonindustrial eyewear) and Z87 (industrial safety eyewear), or, as a minimum, those clear or tinted lenses called for by a ruling of the Food and Drug Administration,—HEW, effective January 1, 1972.

Eyeglass and sunglass lens materials presently available are not completely "impact-resistant." However, impact-resistant lenses securely held in well-designed, nonflammable frames, do afford considerable and desirable protection for eyesight. The safety variety recommended for use in industry and educational labs and shops afford maximum protection.

*Medically Approved Emergency Care of Eye Injuries**

FOREIGN BODIES IN THE EYE

1. Wash hands before examining the eye.
2. If the foreign body is on the surface of the membrane lining of the eyelid, flush the eye with clean water. Eye fountains (see Fig. 7) are best for irrigating the eye but any source of water is satisfactory.
3. If the foreign body is embedded in the eyeball, notify the parent and advise him to take the child to a physician as soon as possible.
4. Superficial bodies can sometimes be removed by everting the eyelid and gently touching the foreign body with a moist cotton applicator or the corner of a clean handkerchief (never use dry cotton around the eye). Occasionally a foreign body under the upper eyelid can be removed by grasping the lashes between the finger and thumb and pulling the lid forward and downward over the lashes of the lower lid.
5. Never, under any circumstances, use an instrument to remove foreign bodies from the eye. Never rub the eye; for in so doing, the object may be driven farther into the tissue and may make removal more difficult.

EYE WOUNDS OR BRUISES

1. For wounds or bruises of eyeball, notify parent and advise him to place the child in care of a physician immediately.
2. For wounds or bruises of the eyelids and soft tissue around the eye, apply sterile gauze dressing and hold in place with a firm bandage. The more severe wounds or bruises of the eyelid should be referred, through the parent, to a physician.
3. A "black eye" or "shiner" is caused by hemorrhage into the soft tissue around the eye. Sometimes the white part of the eyeball is hemorrhagic also. The blow may cause a laceration of the cornea, which will produce severe pain. A "black eye" should not be taken lightly. It should be seen by an ophthalmologist or personal physician.

CHEMICAL BURNS OF THE EYE

1. Irrigate chemical burns of the eye immediately and copiously for 20 min-

*A designated professional person in each school building should be responsible for administering emergency care.

FIG. 7. Emergency eye-care fountain.

utes with clean water, by tilting the head toward the injured side, holding the eyelid open with finger and thumb, and pouring the fluid slowly into the eye. Water poured into the inner corner of the eye (never directly on the eyeball), with eyelid held apart, will enable the chemical to be flushed out of the eye.

2. Notify the parent and get the child to a physician as soon as possible.

HOT METAL BURNS OF THE EYE

1. Do not irrigate. Apply sterile pad.
2. Notify parent and advise him to consult a physician at once.

Accident Reporting and Health Records

The standardized reporting of student and teacher accidents will provide resource information with which local schools may compare their own status and evaluate the progress of their safety program. This is especially important in states where eye safety is required by law. Consistant with such practice is having medically approved emergency care procedures which are made known to the entire school staff.

Vital to an effective program of accident prevention is administrative understanding, supervision, and guidance. Most important of all is continuing support.

The form used for recording accident data should facilitate follow-up—investigation and analysis. Furthermore, it should indicate the part of the body injured and the nature and degree of the injury. The immediate action taken should be noted also.

School Community Relationships

Safe living is everyone's business. A safety program involves every activity of living in our country. From the national to the local school level, private and public organizations are concerned with the prevention of accidents and the preservation of lives. Any local plan which involves a school child will include the school, but will also command the attention of parents, branches of the city and state governments (Fire, Police, Boards of Health, Building Codes), and organizations devoted to safety problems.

B. School Illumination

Introduction

In designing a complete setting that allows for the total comfort and performance of students, the proper visual environment is as important as the proper sonic, spatial, and esthetic effects in providing maximum communication. Since vision plays a major role in the communication of knowledge, it is most important that maximum visibility be provided. Research in the last 30 years has produced basic principles on which the design of the optimal visual environment may be based. Not only must the best conditions for seeing be assured, but the combination of light, color, form, and texture used should provide stimulating surroundings, thereby ensuring maximum motivation.

Effect of Educational Space

The requirements of educational programs and community services have a marked effect upon the design of school lighting. "Traditional" educational programs generally are housed in classrooms for one teacher and a group of from 25 to 35 pupils. Such classroom spaces containing from 650 to 1000 square feet of floor area offer fewer lighting design problems than do those which provide housing for several teachers and from 50 to 400 pupils, with floor area on the order of 6000 square feet. The recent trend toward such large open spaces without partitions, or with only low movable partitions, requires comprehensively planned lighting that can supply

illumination not only for large areas but for small groups as well. Luminaries* in large expanses of ceiling that might be seen from anywhere in the space require careful shielding so that there will be no sense of glare.

Design of the Luminous Environment

Research has established certain principles which govern lighting design:

Light for Seeing of Tasks. First, there should be sufficient light to enable the performance of a visual task, taking into account the size, the configuration, and the contrast of the details and objects against their immediate background. School tasks are numerous and vary widely, from reading and writing to manuscripts, writing on chalkboards or in music scores, and details in the shop, in grooming, and in home economics. Measurements have been made on a series of visual details encountered at various locations in schools, and the levels of illumination necessary for quick, accurate seeing have been established. [Illumination as a quantity is expressed in footcandles and is a measure of the light incident on a surface. The light reflected from a surface (i.e., the brightness), the light by which we actually see, is expressed in footlamberts.]

Effect of Surroundings. It has been found that the relationship between the brightness of the task and the brightness of its immediate and more remote surroundings affects the ability to see it. Laboratory studies indicate that the smaller the difference between the brightness of the visual surroundings and that of the visual task the higher the efficiency of seeing. However, equal brightness in all areas of the room would result in a marked feeling of monotony. Investigation has shown that the immediate surroundings should be less bright than the task, but not less than one third as bright. The brightness of other areas in the field of view should not be less than one third that of the task, and should never be greater than five times that of the task (see Fig. 8). These ratios apply to large areas of the surroundings. They can be achieved by the use of ordinary lighting equipment and light-colored room surfaces. Every object reflects some portion of the light it receives, and the percentage reflected is known as reflectance. The reflectances of floor and furniture should be in the range of from 30% to 50%, the walls from 40% to 60%, and the ceiling from 70% to 90% (see Fig. 9).

*Luminaire: A complete lighting unit consisting of a lamp or lamps together with the parts designed to distribute the light, to position and protect the lamps, and to provide power supply.

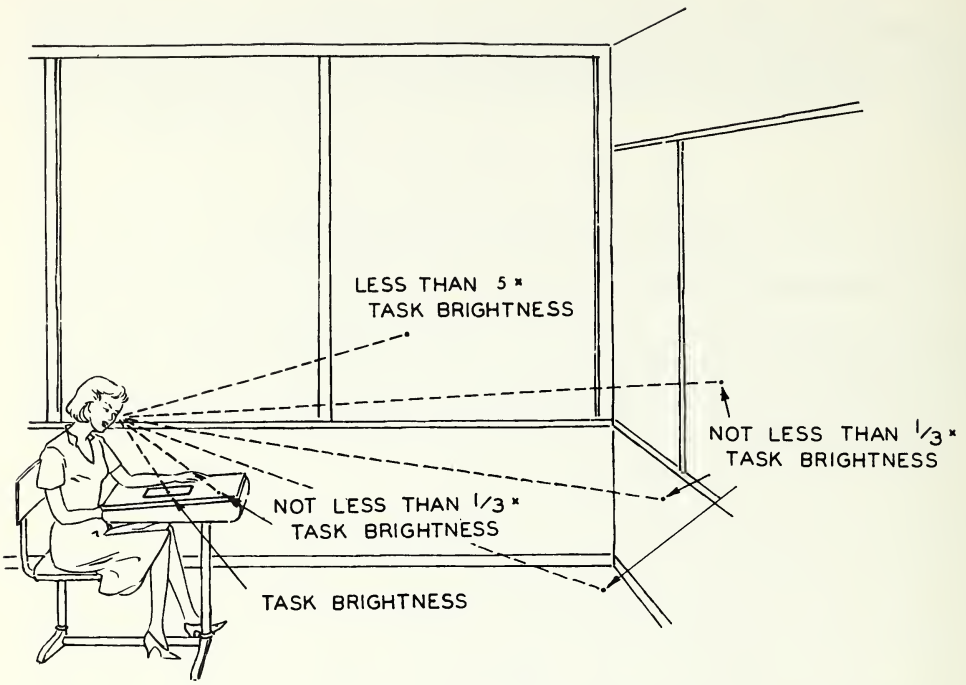

FIG. 8. In a classroom, the brightness of significant surfaces should not differ greatly from the visual task (Courtesy Illuminating Engineering Society).

Limitation of Brightness of Luminaries. Glare is a sensation produced by brightnesses within the visual field that are sufficiently greater than the brightness to which the eyes are adapted causing annoyance, discomfort, or a loss in visual performance and visibility. If the luminaries do not occupy an appreciable portion of the visual field, their brightness should be limited in accordance with the criteria for "discomfort glare." The recommended evaluation system is called "Visual Comfort Probability." For classrooms the value of VCP should be not less than 70—i.e., 70% of the occupants are comfortable, even when seated where the maximum number of luminaires are in their field of view. The bright spots in the luminaire should be kept within a ratio of from three to five times the average brightness. This comprehensive system in general requires computer processing in order to obtain the VCP rating of a particular luminaire system for rooms of various sizes. Because most luminaires will be the brightest things in the room, it is important to verify field claims of VCP ratings. The most desirable approach for the planner would be to arrange for a luminaire to be picked up from the distributor's stock in the local area and sent to an independent testing laboratory for photometric data and

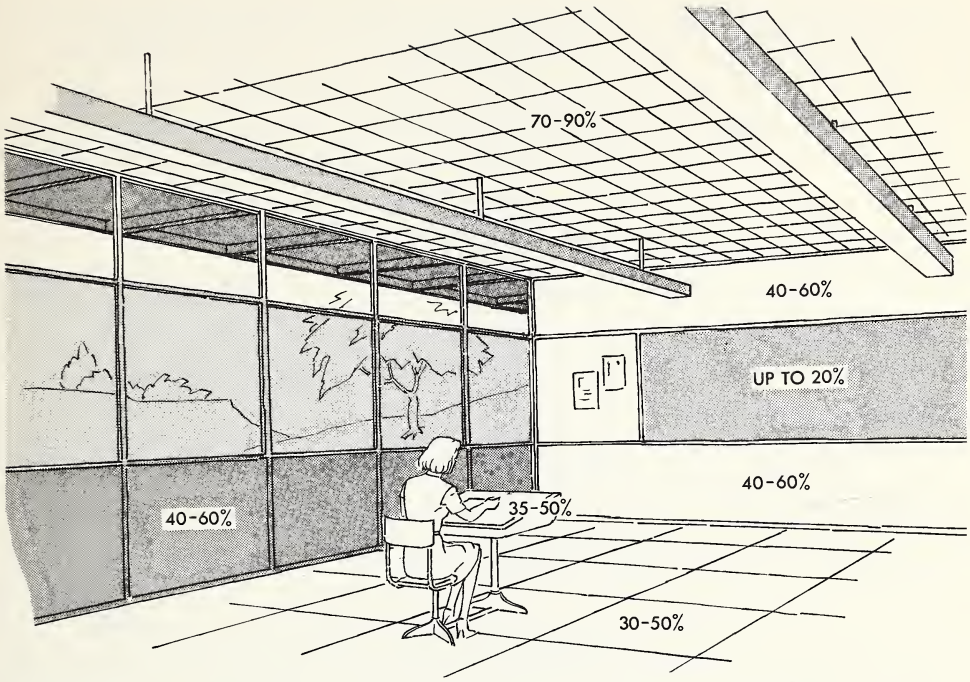

FIG. 9. Recommended reflectances for surfaces and furnishings in the classroom (Courtesy Illuminating Engineering Society).

attendant VCP ratings, and ratios of maximum to average brightness values at different angles of view.

An alternate simplified method of providing an acceptable degree of comfort as defined above and compatible with the VCP method has been derived from the formulas for discomfort glare. This simplified method is based on the premise that luminaire designers do not design different units for rooms of different sizes, but consider the probable range of room sizes and then design for the more difficult potential glare situation such as the larger rooms where more units are in the field of view. (In rooms less than 20 feet in length and width the luminaries are largely out of the field of view.) Accordingly, a room 60 by 60 by 10 feet with an illumination of 100 footcandles has been selected as representative. Furthermore, the principle of flexibility in rearranging classroom space increasingly calls for the moving of partitions. Luminaires designed for glare protection in larger spaces will furnish even more comfort in smaller spaces, and if small spaces become larger, the protection is still there. This calculation method converts the brightness of a nonuniformly bright luminaire into the

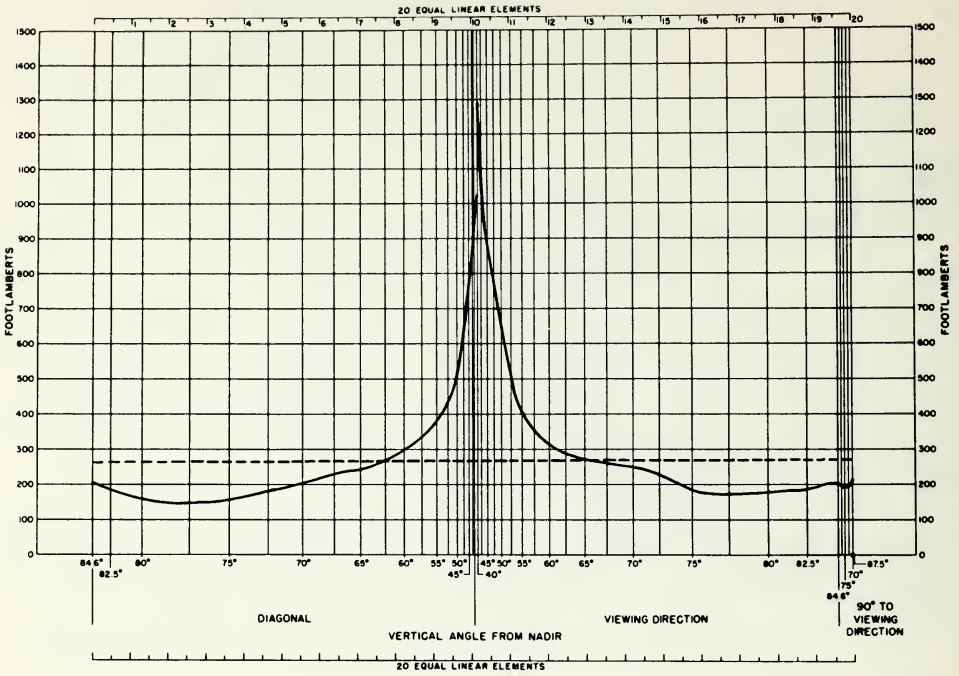

FIG. 10. Equal area—equal glare effect diagram (Courtesy Illuminating Engineering Society).

equivalent brightness of a uniform luminaire. For a 60 by 60 by 10-foot space the equivalent brightness should not exceed 320 footlamberts (see Fig. 10).*

Veiling Reflections. While the above criteria satisfy the requirements of the general visual environment, recent research has shown that strong downward components from ceiling-mounted luminaires cause serious losses in visibility due to veiling reflections† in the pencilled and printed characters of regular classroom work. A special school study (Sampson, 1970) indicates that commonly used luminaire systems have only 15 to 50% effectiveness in revealing the details of the task. Therefore the lighting system should provide a minimum of downward light immediately over the desks in comparison to the light coming from wider angles, which does not cause glossy reflections toward the eye (see Fig. 11).

*There are some correction factors to these values when the distribution of light from the luminaire departs markedly from the usual general diffuse type of emission.

†Veiling reflections: Regular reflections which are superimposed upon diffuse reflections from an object, and which partially or totally obscure the details to be seen by reducing the contrast.

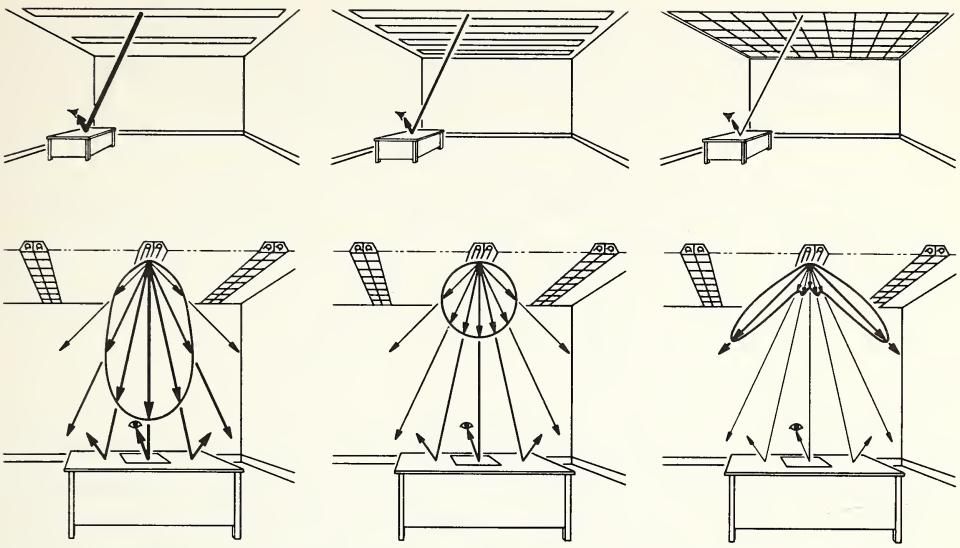

FIG. 11. Varying degrees of detrimental specular light (Courtesy Illuminating Engineering Society).

Pleasantness of Interiors. The pleasantness of any interior is aided by the tasteful selection of color combinations. These should be chosen in consultation with the architect or interior designer, but should have the reflectances necessary to provide the proper brightness ratios for efficient vision. A study of pleasing color combinations is available for the designer's use (Helson and Lansford, 1970).

C. Nutrition

Good nutrition is necessary for normal growth and development and is essential throughout life for the health and optimum functioning of the whole body, including the eyes.

A well-balanced diet includes a selection of foods each day to supply enough PROTEIN to provide all the essential amino acids; sufficient calories from CARBOHYDRATE and FAT to maintain desirable weight and provide energy; a source of FAT to supply essential polyunsaturated fatty acids; VITAMINS and MINERALS to carry out the chemical reactions of body metabolism; and adequate amounts of WATER.

A poor diet can result in disease and bodily impairment. Changes in the eye leading to visual impairment and blindness can be the result of severe malnutrition, especially a lack of vitamin A or vitamins of the B

complex over a long period of time. In some diseases of altered metabolism, such as diabetes mellitus and hyperthyroidism, and in inborn errors of metabolism, such as galactosemia, eye involvement occurs.

Vitamin A Deficiency

In many underdeveloped countries Vitamin A deficiency is widespread and remains one of the major causes of impairment of vision and even total blindness.

Night blindness, the inability to see in dim light, is an early manifestation. Throughout history, night blindness in peoples living under various conditions of privation has been recorded.

Severe vitamin A deficiency produces xerophthalmia, a disease which frequently leads to blindness. Younger children, between 6 months and 4 years, are much more susceptible to this disease than older children. In many of the countries of south and east Asia, in the Near East, North Africa, Central America, and South America, and especially in such rapidly growing urban centers as Hong Kong, Djakarta, Manila, Saigon, and Dacca, xerophthalmia is a major cause of blindness in children and is responsible for thousands losing their sight each year. Xerophthalmia is often precipitated by such serious childhood infections as gastroenteritis and measles, by the semistarvation regimens often used as treatment in these conditions, and by a generally poor state of protein-calorie nutrition.

The ocular manifestations of vitamin A deficiency merit special attention not only because the destructive corneal lesions lead to permanent impairment of vision, but also because they are the only reliable clinical evidence of this deficiency state in man. Unfortunately, serum levels of vitamin A do not correlate well with eye changes indicative of early vitamin A deficiency.

Although Bitot's spots on the conjunctiva are classically associated with vitamin A deficiency and are frequently present in this deficiency, they can also be present when there are no other signs of lack of vitamin A and when the diet provides ample quantities of the vitamin or its precursor, beta-carotene.

Vitamin A deficiency may occur in people who are on adequate diets, but who are subject to poor absorption or utilization. A number of diseases, such as celiac disease, sprue, cystic fibrosis, liver disease, and chronic nephritis may produce this type of secondary vitamin A deficiency.

Hypervitaminosis A

Vitamin A is one of the few vitamins which is definitely toxic when taken in

excessive amounts over too long a period of time. The toxicity results because the unused vitamin A is stored in the liver and not excreted as are the water-soluble vitamins. Some of the rather bizarre symptoms resulting from toxic doses of vitamin A are ocular. In acute toxicity, diplopia and the sensation of lights before the eyes (in adults) and papilledema accompanying an increase of intracranial pressure (in children and adults) have been the most frequent. More and more cases of chronic hypervitaminosis A are being reported, usually occurring in young children given very high doses of vitamin A—100,000 IU or more daily—for many months.

Nutritional Retrobulbar Neuropathy

Nutritional retrobulbar neuropathy (nutritional amblyopia) produces blurring of vision for both near and distant objects, frequently accompanied by photophobia and retrobulbar pain. The precise cause of nutritional amblyopia is not known; however, the response to general improvement of the diet to include supplements of B complex vitamins is usually favorable.

Amblyopia also occurs in chronic alcoholism and tobacco addiction. This type of amblyopia may be due to malnutrition which is secondary to the anorexia, chronic gastritis, and other metabolic effects of the addiction. Vitamin B_{12} appears to be especially effective in treating this condition, and good results have been obtained with thiamine and riboflavin.

Vitamin B Complex Deficiency

Wernicke's encephalopathy, caused by acute deficiency of thiamine, occurs under conditions of deprivation, as in prison camps, and is also seen in the terminal stages of chronic alcoholism. A similar state has been attributed to deficiency of niacin. Eye signs of this condition include nystagmus, fatigue and paralysis of some of the eye muscles, loss of visual acuity, and papilledema.

Riboflavin Deficiency

Riboflavin deficiency found in individuals who consume a marginal diet devoid of animal protein sources and limited in leafy vegetables and legumes, is characterized by capillary overgrowth around the cornea of the eye, among other symptoms. Other eye changes reported in riboflavin deficiency include papilledema, extraocular paralysis, diplopia, exophthalmos, and superficial retinal hemorrhages.

Other vitamin B deficiency conditions which have been reported are fundus changes in infantile beriberi due to thiamine deficiency, riboflavin-

responsive impairment of dark adaptation of disturbance of vitamin B_{12} metabolism in diabetic retinopathy, and widespread hemorrhages in the retina in megaloblastic anemias of nutritional origin.

Other Nutrients

Hypocalcemia and hypercalcemia are capable of causing damage to the eye. The etiology is complex, and a variety of conditions may be responsible. For example, there can be corneal calcification in those conditions in which the blood calcium levels are high, such as vitamin D poisoning, hyperparathyroidism, sarcoidosis, severe renal damage, and so-called milk-alkali disease.

Endocrine and Metabolic Disease

Visual impairment, eye changes, or eye diseases occur in certain endocrine and metabolic diseases, including diabetes, thyroid diseases, and rheumatic diseases.

Some endocrine and metabolic disorders, such as mongolism, myotonia atrophica, and galactosemia, are associated with cataract production, presumably by interference with the nutrition of the lens of the eye. Toxemia of pregnancy, is associated with vascular changes within the eye.

Summary

Good nutrition can help protect vision. However, malnutrition, with resultant eye disease and visual impairment often leading to blindness, still remains a vital threat to millions of people in the underdeveloped areas of the world.

CHAPTER 6

VISION AND READING DIFFICULTIES

All children who have reading difficulties or other learning problems (among them dyslexia) and who experience scholastic failure, regardless of cause, should have a thorough eye examination included in their physical, mental, and emotional evaluation.

Dyslexia is a specific inability to read well or understand printed symbols in an otherwise normal individual. This term has become popularly known, but is subject to a great deal of misunderstanding.

True dyslexia makes up an extremely small percentage of children with learning disabilities. The true dyslexic probably has no significant primary emotional deficiencies, has normal or better intelligence, no medical history of acquired problems, minor or no neurological problems, and makes quite specific errors in reading and writing.

In reading, the eyes are an essential intermediary between the symbols on the printed page and the brain where these symbols are interpreted. It is natural to attribute reading difficulties mainly to the eyes and vision. However, eye function has been found to have little bearing on the act of reading other than to transmit word recognition to the brain.

Therefore, a logical approach to dyslexia and the problems associated with reading failure should be:

First, accurate early diagnosis and remediation in the lower grades enhances the possibility of improvement or correction.

Second, each child's ability to master reading and other academic pursuits must be carefully determined. This includes unbiased intelligence testing, vision screening, and a careful study of environmental factors affecting the child in the period prior to and during his school years. Management of learning disabilities, including dyslexia, requires a multidiscipline approach including, in many instances, examination of the eyes, ears and nervous system as well as a psychological, educational, and speech

evaluation. In general, a child learns in direct proportion to his ability to learn and functions best in an environment conducive to learning.

Third, the curriculum of our schools must be examined and realigned to meet the needs and fit the capabilities of individual students. Learning materials must then be presented at a pace and in an atmosphere adapted to optimum learning for each child.

Children found to have a multiple etiology for their reading disability challenge the educator and health specialist. Help for these children will most likely be found through educational research and practice. Educational advances in teaching the disabled reader are essential. There is reason to anticipate better management of reading disabilities because of the current attention to these problems and to research toward prevention and remediation.

APPENDIXES

Appendix A: Glossary of Commonly used Eye Terms*

ABDUCTION (ab-duk'shun)
Turning outward from axis of body

ACCOMMODATION (ah-kom'o-da'shun)
Adjustment of the eye for seeing objects at various distances, accomplished by altering the shape of the crystalline lens by action of the ciliary muscle, thus changing its power and focusing a clear image on the retina

ACCOMMODATION, NEAR POINT
The nearest point at which the eye can see an object distinctly. It varies according to the power of accommodation (qv) in the individual

ADDUCTION (ah-duk'shun)
Drawing toward the muscle

AMBLYOPIA (am"ble-o'pe-ah)
Dimness of vision without any apparent organic cause

AMBLYOPIA EX ANOPSIA (ex anop'sia)
Amblyopia acquired through lack of use of the eye

ASTIGMATISM (ah-stig'mah-tizm)
Defective curvature of the refractive surfaces of the eye as a result of which light rays are not sharply focused on the retina for either near or distance

BINOCULAR VISION (bin-ok'u-lar)
The inability to use the two eyes simultaneously to focus on the same object and to fuse the two images into a single image which gives a correct interpretation of its solidity and its position in space

BLEPHARITIS (blef"ah-ri'tis)
Chronic inflammation of the margins of the eyelids including the hair follicles and sebaceous glands

CATARACT (kat'ah-rakt)
A condition in which the crystalline lens of the eye becomes opaque with consequent loss of visual acuity

CHALAZION (kah-la'ze-on)
Chronic enlargement of one of the meibomian oil glands in the eyelids forming a hand round lump due to blocking of the gland opening

CHOROIDITIS (ko"roid-i'tis)
Inflammation of the choroid (the blood vessel layer of the eye) due to an infection or allergy

CONES AND RODS
The two types of light-sensitive nerve endings that are present in the retina and make it possible for it to transmit visual impulses to the brain. Cones are sensitive to fine detail and color; rods are concerned with motion and vision at low degrees of illumination (as in night vision)

CONGENITAL (kon-jen'i-tal)
Present at birth

CONJUNCTIVITIS (kon-junk"ti-vitis)
An inflammation of the conjunctiva

CONTACT OR CORNEAL LENSES (kon'takt, kor'ne-al)
Lenses so constructed that they fit directly on the eyeball; used for the cor-

* See p. 8 for descriptions of parts of eye.

rection of vision in cases having a cone-shaped cornea and for cosmetic reasons. Corneal lenses are also used after cataract (lens) extraction to replace the lens removed from the eye, because they provide less distortion and image size difference from the other eye than spectacles would

CONVERGENCE (con-ver'jens)
The process of directing the visual axes of the two eyes to a near point, with the result that the pupils of the two eyes are closer together, or turned inward

CONVERGENCE, NEAR POINT
The nearest point at which the two eyes can direct their gaze simultaneously; normally about three inches from the nose

CORNEAL GRAFT
Operation to restore vision by replacing a section of opaque cornea with transparent cornea

CYCLOPLEGICS (si"klo-ple'jiks)
A group of drugs, instilled into the eye, which cause temporary paralysis and relaxation of the ciliary muscles which control accommodation and dilation of the pupil; often used to ascertain the error of refraction

DACROCYSTITIS (dak"re-o-sis-titis)
Inflammation of the lacrimal sac (tear sac)

DIOPTER (di-op'ter)
Unit of measurement of strength or refractive power of lenses

DIPLOPIA (di-plo"pe'ah)
Double vision, i.e., perception of two images of a single object

DIVERGENCE (di-ver'jens)
Simultaneous turning outward of both eyes away from each other

DYSLEXIA (dis-lek'se-ah)
Inability to read or understand printed symbols which may be caused by many factors

EMMETROPIA (em-e-tro'pe-ah)
Refractive condition of the normal eye, at rest, which brings the image of distant objects to a focus on the retina

ENUCLEATION (e-nu"kle-a'shun)
Complete surgical removal of the eyeball

ESOPHORIA (es"o-fo're-ah)
Latent tendency of the eye to turn inward (see heterophoria)

ESOTROPIA (es"o-tro'pe-ah)
An observable turning inward of one eye (convergent strabismus or crossed eye)

EXOPHORIA (ek-so-fo're-ah)
A latent tendency of the eye to turn outward (see heterophoria)

EXOPHTHALMOS (ek"sof-thal'mos)
Abnormal protrusion or bulging of the eyeballs from their sockets

EXTORTION (eks-tor'shun)
Outward rotation

EXOTROPIA (ek"so-tro'pe-ah)
(divergent strabismus)
Observable turning outward of one eye (or both) from the visual axis of the other

FIELD OF VISION
The entire area which can be seen at one time by the fixed eye, i.e., without shifting the head or eyes

FOCUS (fo'cus)
Point to which rays are converged after passing through a lens; focal distance is the distance rays travel after refraction before focus is reached

FUSION (fu'zhun)
Coordination of the separate images seen by each eye into one

GLARE
A quality of light which causes discomfort in the eye; it may result from a direct light source within the field of

vision or from a reflection of a light source not in the field of vision

GLAUCOMA (glaw-ko'mah)
Disease of the eye marked by a mechanical increase in the intraocular pressure causing organic changes in the optic nerve and defects in the visual field

HETEROPHORIA (het"er-o-fo're-ah)
A tendency of the eyes to deviate from the normal position for binocular fixation, counterbalanced by simultaneous fixation and fusion (prompted by the desire for single binocular vision). Deviation is not usually apparent, in which case it is called latent heterophoria

HETEROTROPIA (het"er-o-tro'pe-ah) (squint, strabismus, cross-eye)
When one or more muscles are out of balance, one eye may turn in while the other fixes. It may be a divergent or vertical muscle

HORDEOLUM (hor-de'o-lum) (a sty)
Inflammation of one or more of the sweat glands found around the roots of the eyelashes

HYDROPHTHALMUS (hi"drof-thal'mos) (congenital glaucoma)
A rare congenital defect in which the eyeball is abnormally large as a result of pressure elevation. It is present at birth or develops early in infancy

HYPEROPIA (hi"per-o'pe-ah) (hypermetropia, farsightedness)
Condition of eye in which light rays from distant objects are brought to focus behind the retina when the eye is at rest

IRITIS (i-ri'tis)
Inflammation of the iris; condition marked by pain, inflammation, discomfort from light

KERATITIS (ker"ah-ti'tis)
Inflammation of the cornea

LACRIMAL GLAND (lak'ry-mal)
A gland, located just above the outer corner of each eye, which secretes tears

LACRIMATION (lak"ry-ma'shun)
Production of tears

LAGOPHTHALMOS (lag"of-thal'mos)
Inadequate closure of the eyelids

LENS, CRYSTALLINE
A refractive medium having one or both surfaces curved

LENS, CONCAVE
Lens having the power to diverge (qv) rays of light; also known as diverging, reducing, negative, myopic, or minus lens, denoted by the sign (—)

LENS, CONVEX
Lens having power to converge (qv) rays of light and bring them to a focus; also known as converging, magnifying, hyperopic, or plus lens, denoted by the sign (+)

LUMEN (lu'men)
A unit of measurement of the light output or brightness of light source. Light bulbs are now rated in lumens, in addition to wattage designation

MICROPHTHALMIA (mi"krof-thal'me-ah)
Abnormal smallness of the eyes

MYOPIA (mi-o'pe-ah)
A refractive error in which rays of light come to a focus in front of the retina as a result of eyeball being too long from front to back, or having excessive curvature of cornea or lens

NYSTAGMUS (nis-tag'mus)
An involuntary movement of the eyeballs rapidly from side to side, up and down, in a rotary motion, or mixed

OCCLUSION (o-kloo'zhun)
Act of obscuring the vision of one eye, so as to force the use of the other eye

OPTIC ATROPHY (at'ro-fe)
Wasting away of the optic nerve fibers

characterized by pallor of the optic nerve head and accompanied by visual loss

OPHTHALMOLOGIST (of'thal-mol'o-jist) (oculist)
A physician—an M.D.—who specializes in diagnosis and treatment of all defects and diseases of the eye by prescribing drugs, glasses and other types of treatment including surgery

OPTICIAN (op-tish'an)
Grinds lenses, fits them into frames, and adjusts frames to the wearer

OPTOMETRIST (op-tom'e-trist)
A licensed, nonmedical practitioner, measures refractive errors—that is, irregularities in the size or shape of the eyeball or surface of the cornea—and eye muscle disturbances. In his treatment the optometrist uses glasses, prisms, and exercises only*

ORTHOPTIST (or'thop'tist)
A person who uses a series of scientifically planned exercises for developing or attempting to restore the normal teamwork of the eyes

PHORIA (fo're-ah)
A latent tendency toward crossed eyes. Condition not usually observed. See esophoria, exophoria, and heterophoria

PINEGUECULA (ping-gwek'u-lah)
A small, yellowish, often triangular, spot or swelling in the conjuctiva to either side of the cornea, usually on the nasal side. It is not painful. Most commonly seen in older people

PRESBYOPIA (pres'be-o'pe-ah)
Decreased elasticity of the lens in the eyeball causing some loss of accommodation (qv), and usually seen in older persons

PRISM (prizm)
A wedge-shaped piece of glass or plastic which possesses the power of refracting (bending) rays of light toward its base

PETERYGIUM (te-rij'e-um)
A condition in which a triangular membrane forms extending from the conjunctiva to (the margin of) the cornea

PTOSIS (tos'sis)
A drooping of the upper lid due to weakness or paralysis of a portion (or branch) of the third nerve which controls the levator muscle that raises the lid

REFRACTION (re-frak'shun)
The bending or deviation of rays of light in passing obliquely from one medium to another of different density; the determination of the refractive errors (qv) of the eye and their correction by prescription of glasses

REFRACTIVE ERROR
A defect in the eye's ability to bring light rays to focus on the retina

RETINAL DETACHMENT (ret'i-nal)
Separation of the retina from the underlying vascular or choroid layer of the eye breaking connections between the rods and cones and the pigment layer. Most often the result of a hole or tear in the retina

RETINITIS (ret"i-ni'tis)
Inflammation of the retina

RETINITIS PIGMENTOSA (pigmento'sa)
A form of hereditary degeneration of the retina which begins as night blindness, but which produces a gradual loss of vision which may be complete

RODS
See Cones and Rods

SCOTOMA (sko-to'mah)
An abnormal blind spot in the field of vision surrounded by an area of normal vision

STEREOPSIS (ste"re-op'sis)
Depth perception

STRABISMUS (strah-biz'mus)
Manifest deviation of the eyes so they

are not simultaneously directed to the same object. See heterotropia

TELESCOPIC LENSES
Special lenses for persons with advanced degrees of sight impairment. Two lenses, properly ground and mounted in a spectacle frame, with a short distance between them to form a sort of telescope

TRACHOMA (trah-ko'mah)
Chronic contagious conjunctivitis producing loss of vision

VISION (vizh'un)
The ability to see and interpret what is seen

VISUAL ACUITY (ah-ku'i-te)
Sharpness of vision, the ability of the eye to distinguish detail

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Elementary

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Anderson, CL, *School Health Practice,* Saint Louis: C.V. Mosby, 1968.

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Appendix E.: Films and Film Strips

Before We Are Six
Expedite School Eye Safety
Eyes for Tomorrow
Glaucoma: Sneak Thief of Sight
Johnny's New World
The Smartest Kid in Town
(Available from: National Society for the Prevention of Blindness, Inc., 79 Madison Avenue, New York, New York, 10016)

Your Eyes: Ways We Depend on Them (K-G3)
Eyes and Vision (G4-6)
Eyes and Seeing (G7-9)
Eyes and Their Care (G7-9)
The Eye-Visual Accommodation
The Eye-Nearsightedness
The Eye-Farsightedness
(Available from: Encyclopedia Brittanica Films, Sales and Service Department, 425 North Michigan Avenue, Chicago, Illinois, 60611)

Eyes: Their Structure and Care (G7-9)
Our Wonderful Eyes and Their Care (G7-9)
See Better, Healthy Eyes (G4-6)
(Available from: Coronet Instructional Films, 65 East South Water Street, Chicago, Illinois, 60601)

Why We See Like Human Beings
Sound filmstrips in color:
Our Eyes and How They Work (Interm-Sr. H.S.)
Vision Problems and Eye Care (Interm-Sr. H.S.)
(Available from: Society for Visual Education, Inc., 1345 Diversey Parkway, Chicago, Illinois 60614)

You and Your Eyes (K-G3)
(Available from: Walt Disney Productions, 495 Route 17, Paramus, New Jersey, 07652)

How The Eye Functions (G7-9)
(Available from: Knowledge Builders Films, Vision Education Building, Lowell Avenue and Cherry Lane, Floral Park, New York, 11001)

Health and Eyes (K-G3)
(Available from: Eye Gate House, 14601 Archer Avenue, Jamaica, New York 11435)

The Human Eye (G1-H.S.) (22″ x 37″ full color wall chart) (Available from Scott, Foresman, and Company, 1900 East Lake Avenue, Glenview, Illinois, 60025)

Appendix F: Sources of Materials and Resources

American Academy of Ophthalmology and Otolaryngology
14 Second Street, S.W., Rochester, Minnesota 55901

American Association of Ophthalmology
1100 17th Street, N.W., Washington, D.C. 20036

American Optometric Association
7000 Chippewa Street, St. Louis, Missouri 63119

American Public Health Association
1015 Eighteenth Street, N.W., Washington, D.C. 20036

American School Health Association
107 S. Depeyster, P.O. Box 416, Kent, Ohio 44240

Better Vision Institute, Inc.
630 Fifth Avenue, Rockefeller Center, New York, New York 10020

Joint Committee on Health Problems in Education
of
National Education Association of the United States
1201 16th Street, N.W., Washington, D.C. 20036
and
American Medical Association
535 North Dearborn Street, Chicago, Illinois 60610

Metropolitan Life Insurance Company
One Madison Avenue, New York, New York 10010

National Society for the Prevention of Blindness, Inc.
79 Madison Avenue, New York, New York 10016

Public Agencies

Federal

Maternal and Child Health Services
Health Services and Mental Health Administration
Department of Health, Education and Welfare
Rockville, Maryland

State

Health Departments (state, city, and local)
State Departments of Public Instruction

Appendix G: Pamphlets Available from the National Society

Vision Screening of Children	(P257)
A Guide for Eye Inspection and Testing Visual Acuity	(P200)
Signs of Eye Trouble in Children	(G102)
Most Wonderful Eyes in the World	(G105)
Why Safety Glasses?	(G112)
Professor Ludwig Von Drake's I.Q.	(G114)
Charlie Brown, Detective	(G116)
First Aid for Eye Emergencies	(G117)
Classroom Lighting	(G301)
The Human Eye	(V7)
Preschool Vision Screening	(P253)
Vision Screening of Children	(P257)

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